FOOD PLANNING FOR FOUR HUNDRED MILLIONS

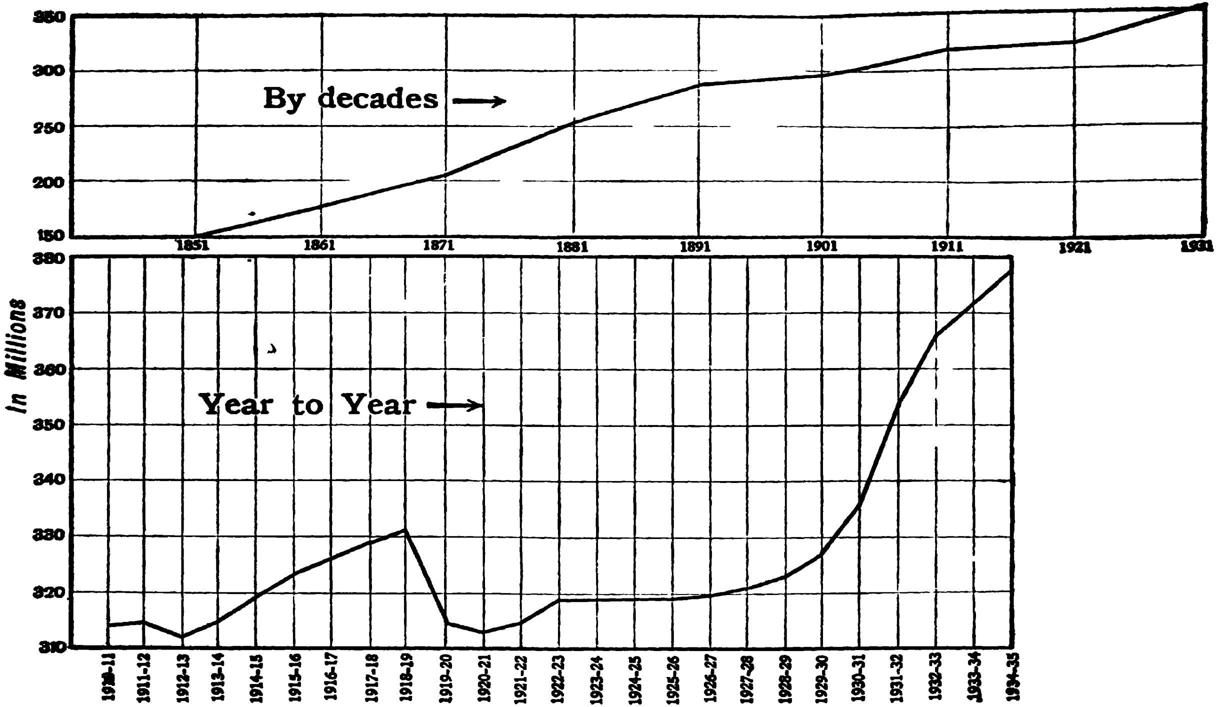

FIG. 1.—POPULATION INCREASE IN INDIA (Frontispiece)

FOOD PLANNING
FOR
FOUR HUNDRED MILLIONS

BY

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PREFACE

THE subject of population pressure has now come to the forefront in India, as she has threatened to pass the limit of four hundred millions by the next Census year. Unfortunately there is no topic which is being discussed with more dogmatism, prejudice and even superstition than the movement of population. The scheme of representation by religions and castes in the new Constitution has recently imported political fervour into the discussion of numbers. Among the economists of the country, again, the subject has received much less attention than it deserves. It was for these reasons that the first Indian Population Conference, at its session at Lucknow in 1936, devoted its exclusive attention to the various phases of the Indian population problem. This book is the first-fruit of the investigations which were begun before the Conference and expanded since taking up the work of the newly founded Institute of Population Research—an outgrowth of that Conference.

I have here sought to survey briefly the trend of food position in relation to population increase in India and to estimate her total population capacity and food shortage, following the well-known methods adopted in this connection by Pearl and Taylor for the U.S.A. The standards of food requirements for the Indians have not been worked out as yet by the physiologists. With the collaboration of the Physiological Laboratory in the King George's Medical

College, Lucknow, I have fixed up two theoretical standards, one for Northern India and another for Bengal and Southern India, on the basis of which various peasant and working-class diets, collected from the different Provinces, have been scrutinised and their defects laid bare. A considerable proportion of the peasants and workers, it will be evident, show inadequacy or unbalance in their food intake or both. Probably for the first time certain famine diets, collected by me with the assistance of a medical officer from scarcity-stricken areas in Bengal, have been analysed in the laboratory and the food inadequacy as well as prevalent deficiency diseases have been tabulated.

Apart from famines a slight deficiency of harvests has, I have shown, immediate and marked effects on births, diseases and deaths in India. On account of the great instability of agriculture in considerable parts, and of the population withholding from exercising normal psychological checks over long periods, the birth-rate in India tends to expand and mortality to diminish in sympathy with good harvests and conditions of agricultural water supply generally, while it tends to decrease and mortality tends to increase with bad harvests. Nothing indicates more vividly the absence of any agricultural surplus and the sub-nutritional level at which considerable masses of our population are living at present. The considerable proportion of disease and inefficiency in India has its primary cause in diet deficiency and poverty; the sooner it is universally recognised that the efficacy of curative medicine or even hygiene is a factor of minor influence, the better for the health and happiness of the people. Mal-nutrition increases the morbidity and lowers the efficiency of industrial workers and contributes towards absenteeism, lateness and low output; while among the cultivators it increases the predisposition to diseases, raises mortality, especially infant mortality, and leads to agricultural idleness, indebtedness and poverty, which pursues its heartless course in an ever-widening vicious circle.

We have estimated for India a food deficiency for 12 per cent of the population in a year of normal harvests. This to-day challenges a new population policy and systematic food and crop planning on a country-wide scale, based on the sciences of economics, agriculture and nutrition and guided by true social foresight. Agriculture must now be approached from a new angle in India, viz., devising for each agricultural region an adaptive crop rotation which may ensure the most economical use of land and of man and animal labour on the holding and at the same time yield the highest number of calories per acre. This is the primary adjustment required in the face of the heavy and increasing pressure on the soil.

Foods in the different Provinces depend largely upon regional and agricultural conditions, which definitely limit the cultivators' selection of crops and hence of foods, while scarcity diets show an astonishing adaptability of the people to droughts and deficient harvests. But India can and should in normal times bring up her yields of the chief cereals to the standards of the other heavily populated eastern countries, viz., China and Japan, through more intensive cultivation, better seeds and manures, and the employment of idle and semi-idle labour. With the increase of population pressure not merely should cropping be more diversified but a systematic crop and food planning, which may increase the protein-yielding capacity per average holding and distribute the human and cattle power to better advantage throughout the year, must also be pushed systematically. I have indicated that in certain over-crowded areas the peasant is responding, as in China, to heavier population by an arranged succession of croppings in which the protein-bearing grams, pulses, oil-seeds and vegetables rotate with cereals. But elsewhere unplanned agriculture of poverty-stricken small-holders shows remarkable increase of barley and the cheaper millets, and steadiness or decrease of wheat or rice and the protein-bearing peas and gram—movements opposite to those occurring in Japanese farming. The phenomenal increase of output of jowar and barley, which are inferior in nutritive value to the major cereals, wheat and rice, shows a deterioration of the food position. The former has actually declined in production and the latter, the cereal of about two-thirds of the Indian population, has increased in output by only about 10 per cent during the last twenty-five years. Dairy products the adequate supply of which is particularly necessary for the proper health and development of a non-meat-eating population, are becoming scarcer and scarcer for the great masses of the people. It is a strange paradox that in India, due to ancient sentiments which govern animal keeping, bovine population pressure varies directly with human population pressure. Cattle are increased in numbers by the small cultivators who can afford it least, to compensate for the loss of efficiency that results from a chronic fodder shortage in the zones of human concentration. Systematic crop planning, in response to heavier population pressure, will aim at the expansion and even substitution of peas, grams, pulses and oilseeds for grains, and the increase of heavy-yielding tubers and root crops, including the sweet potatoes, as an indispensable crop adjustment in the overcrowded areas in the United Provinces, Bihar and Orissa, Bengal and Madras. It will also include an expansion of fodder cropping. Unlike what occurs in the West, there is in India a vital link between small farming and keeping of animals which feed on the straw, leaves and stalks of food crops. Much progress in small farming will be achieved if the cultivator grows more fodder-crops and peas and beans, which may be used for the triple purpose of food stuff, animal feed and manure, instead of those cereals and crops such as jute and sugar-cane which have reached the stage of over-production.

But the improvement and cultivation of fodder crops will be futile, if not actually harmful, if the peasants continue their present attitude towards the maintenance of uneconomical and useless cattle, which represent the staggering figure of 125 million heads. It is only a planned programme of restriction of cattle numbers and of controlled breeding which can facilitate the introduction of dairy farming and an intensive system of mixed farming combined with dairying (such as is prevalent in the Punjab, the Western United Provinces and Gujerat) throughout the country. But social sentiments die hard in India, and for several decades the excessive burden of worthless, superfluous beasts will aggravate the poverty of small-holders and the exhaustion of soil and grass-land resources.

A system of adaptive crop planning in response to heavy population must also emphasize the importance of a judicious combination of food crops with industrial crops, especially cotton, sugar, oilseeds, tobacco and hemp. In this way agricultural industries would be developed in the country-side on a scale that would draw off surplus labour from the land. Madras, with her important ground-nut industry, is pointing the way towards such development. If oil and oil-cake could be locally manufactured in India, the oil would add an important source of fat to the peasants' dietary and support soap manufacture and other industries, while the residue would be utilised as a fertiliser or as a cattle feed. The present world economic depression has rendered unremunerative the production of a large number of crops, which formerly played an important part in India's export trade, and with the greater proportionate fall in agricultural than in industrial prices, the small holding in India, which cannot profit much from the advantages of mechanised farming and organised marketing, must resort to a planned combination of food and industrial cropping in order to safeguard the standard of life for the growing millions of agriculturists.

In India during the last three decades there has been a decline in the relative proportion of industrial employment in relation to the total number of workers, this accompanying a process which may be described as de-industrialisation. Between 1911 and 1931 the number of persons employed in industries declined by 2·2 millions, most industries, including textiles and industries of dress and toilet, having suffered loss of numbers of workers. The decline of village arts and handicrafts, coupled with the decrease of employment in large-scale organised industries, due to the depression, have increased the occupational unbalance in the country and the pressure on the impoverished soil. Not merely a forward programme of industrial planning, with the aid of a more vigorous tariff policy, but also systematic effort for the encouragement of inter-provincial migration and overseas settlement will contribute to mitigate the present overcrowding in agriculture. The subject of Indian emigration and settlement has been dealt with in a recent work of mine entitled *Migrant Asia: a Problem in World Population*, where the geographical and economical background of the study of population pressure has covered not only India but the whole of South-eastern Asia.

Various social factors, among which must especially be stressed infant marriage among the lower Hindu castes, and polygamy among the Mohammedans, have contributed towards increase of population. Illiteracy and imprudence, the latter resulting from the long, futile struggle with poverty and social handicaps to economic uplift, prevent the spread of birth-control, so that the ancient crude methods of regulation of the size of the family, viz., abortion and infanticide, are still too widely prevalent.

But sooner or later India will have to adopt the ideal of the small family system which did exist in the past in order to prevent the appalling waste of life now apparent on all sides. Without a voluntary check on the size of the family, all the remedies would tend to be only temporary. For the population will rise again to the maximum number of persons the land can support, upset the established man-land-ratio, and reduce its health and living standards. Thus disease would scourge back population to an average abundance, or prolonged malnutrition would lead to a slackening of birth-rate. Birth-control in India has for its chief object the reduction of mortality rather than restriction of births, and the promoters of the child-welfare movement should definitely adopt as one of their principal objects the broadcasting of practical knowledge about the use of contraceptives and their distribution. Where child-welfare centres have been started in the villages, these could easily become birth-control clinics. With the Indian masses, birth-control, the methods of which are much safer, saner and less cruel than those now in vogue, would ensure a wise spacing of births that would prevent a terrible wastage of human life and economic resources, and open the only available door leading to a higher standard of living. Mis-population is as serious a question as over-population in India, due to the illiteracy and ignorance of the economically backward groups. Here, again, the solution would lie in the spread of education and desire for a better standard of living among the masses, and the abolition of certain marital regulations among the upper classes which, in the face of a natural deficiency of females, are leading to social suicide. Agriculture and industrialisation, nutrition and food customs, the balance of births and deaths and differential fertility among the various social grades, health, efficiency and standard of living, medicine and public hygiene are all implicated in population investigations, which must require the co-operation of experts in diverse fields. While the problem of population is not merely one of economics, and as a programme of removal of illiteracy and of better sanitation is to-day deferred or baffled because population outruns the capacity of education and sanitation, ethics, eugenics and religion must all co-operate in finding out a means of keeping down numbers. In seeking to present a more comprehensive view of the Indian population situation than what we come across, for instance, in the Census Reports, and in endeavouring to analyse the various strands which are woven into the complex texture of the demological process, I am emboldened by the hope that a collaboration of scientific workers in cognate fields will be established before long, bringing about a marriage between agricultural and public health policies so essential for the welfare of India's teeming millions.

Some materials of this book appeared as papers or articles in the *Indian Journal of Economics*, the *Calcutta Review* and the *Journal of the Social Sciences* in India; in the *American Journal of Sociology, Sociology and Social Research*, and *The Asian Review* in the U.S.A., and in the *Proceedings* of the International Congresses of Population in Rome, Berlin and Paris. I have also incorporated two papers presented to the first Indian Population Conference as addresses by the Convener and as Chairman of the Economics Section, and another read before the East India Association, London, in July last under the chairmanship of the Right Hon. Viscount Goschen. The topics of population checks and optimum were recently treated by me in several lectures delivered at the Universities of Cambridge, Oxford and Liverpool; while the relations of population, agriculture and nutrition were discussed in lectures to the Department of Agriculture, Cambridge University, the School of Rural Economics, Oxford and the School of Economics and Political Science, London. Investigations begun under my guidance by post-graduate students of the University, and since published by the United Provinces Government, such as the monographs by Mathur on the *Pressure of Population in Gorakhpur*, by Misra on *Over-population in Jaunpur*, and by Saksena on *Wages and Cost of Living Indices in Cawnpore*, have been helpful. I am deeply obliged to Professor Carr-Saunders, Dr. Kuczynski and Dr. Leslie Harris for some helpful general discussions on population, mal-nutrition and mortality. My thanks are also due to my pupil and now my colleague, Mr. S. P. Saksena, for assistance in dealing with statistical data and their graphic representation.

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CONTENTS

CHAPTER PAGE

PREFACE vii

I. PRESSURE OF POPULATION . . 1

II. POPULATION CAPACITY AND FOOD SUPPLY 15

III. THE MALTHUSIAN CHECKS . . . 34

IV. FOOD STANDARDS AND FOOD VALUES . 55

V. NUTRITION LEVELS IN DIFFERENT REGIONS AND CLASSES . . . 69

VI. AGRICULTURAL ADAPTATION TO POPULATION PRESSURE 85

VII. CROP PLANNING AND NUTRITION . 98

VIII. INDUSTRIAL CROPS AND RURAL INDUSTRIALISATION 108

IX. THE TRIANGULAR CONFLICT: MAN—LAND—CATTLE . . . 123

X. CATTLE CRISES AND DETERIORATION . 137

XI. INCIDENCE OF MAL-NUTRITION . . 154

XII. INEFFICIENCY AND POVERTY . . 173

XIII. REMEDIES OF POPULATION PRESSURE . 190

XIV. NEW SOCIAL ATTITUDES . . . 211

XV. DYSGENIC TRENDS OF POPULATION . 221

LIST OF DIAGRAMS

1. POPULATION IN INDIA . . . *Frontispiece*

PAGE

2. OVER-POPULATION, HUMAN AND BOVINE . . 5
3. MOVEMENT OF INDEX NUMBERS OF FOOD PRODUCTION, AVAILABLE FOOD SUPPLY AND POPULATION 19
4. RELATION BETWEEN HARVESTS AND VITAL STATISTICS IN AGRA DISTRICT, UNITED PROVINCES 49
5. FOOD INTAKE AND FOOD REQUIREMENTS: THE PUNJAB, THE UNITED PROVINCES AND BOMBAY 80
6. FOOD INTAKE AND FOOD REQUIREMENTS: BENGAL, BIHAR AND MADRAS . . . 81

FOOD PLANNING FOR FOUR HUNDRED MILLIONS

CHAPTER I

PRESSURE OF POPULATION

THE MALTHUSIAN PRINCIPLE

That the ancients comprehended the relation between food supply and mortality of the population is indicated in a well-known passage in the *Brihad Aranyaka Upanishad*, in which the food-seeking impulse is identified with Death, which enshrouds the earth. The person who seeks food, explains the commentator, ousts others from the dinner-table. Yet Prājapati, who takes the form of Death, is also the begetter of mankind. How mortality comes in the wake of population increase was, however, first brilliantly analysed by Malthus.

It was Malthus who first warned mankind of the danger of population outstripping the means of subsistence, and enunciated the law of diminishing returns, so important for a country like India which depends mainly on agriculture. For a century it was rather usual to discredit Malthus's doctrines as obsolete. The marvellous developments of manufacturing industries with their economies of large scale production, the application of science to food production, the revolution in transport and vast population movements as well as the rise of marriage age and reduction of birth-rate, have all contributed in the Western countries to mitigate the Malthusian pessimism, although the Malthusian "principle" yet remained for the most part unassailed. Since the European War the spectre of over-population has returned to the West, and in recent years the raising of artificial barriers against movements of trade, industry and labour has aggravated the problems of low wages, unemployment and low standard of living.

But if Malthus has recently come to his own in the West, he has been always of far greater significance to Asia, where about 1,000 millions, i.e., half the human race, are now living in an area which is one-sixth of that occupied by 600 million Euro-American peoples.

Over-population, of course, did not strike Malthus as a possibility, because population would not, according to him, over-step its limits due to misery, war and pestilence. But even in the oriental countries the notion that population automatically regulates itself by external checks has become incompatible with modern social ideals. In fact, with the spread of democratic ideas and institutions in the East, the notions of optimum and over-population have become highly significant along with a desire to regulate population policy. The entire outlook in population study is thus changed, the emphasis being now shifted to the means of social control of numbers and the aims and objects of such regulation, due regard being paid to the qualitative and selective aspects of population changes.

Growth of Population in India

The whole of India, with an area half of that of the United States, has a population almost three times as large. Moreland estimates that at the death of Akbar (1605) the population of India stood roughly at 100 millions. Findlay Shirras thinks that this is an over-estimate. The figures arrived at and published by the Royal Statistical Society in 1847 varied between 100 and 150 millions. Dieteri and Behm raised the figure to 171 millions. McCulloch, in his *Descriptive and Statistical Account of the British Empire* (1847), gives the population of India as 133 millions.[1] We would estimate India's population in the middle of the nineteenth century at 150 millions. The following table shows the increase of population in India since the seventeenth century:

Year		*Population in Millions*	*Increase due to Inclusion of New Areas*	*Actual Increase in Millions*	*Rate per cent of Actual Increase in Successive Inter-Censal Periods*
1600	(Moreland)	100	—	—	—
1750	(Shirras)	130	—	—	—
1850		150	—	—	—
1872		206	—	—	—
1881		254	34	14	1·5
1891		287	5	28	9·6
1901		294	3	4	1·4
1911		315	2	19	6·4
1921		319	—	4	1·2
1931		353	—	34	10·6

In 1935 the population stood approximately at 377 millions. Population increased roughly from 20 to 50 millions in the United Provinces; from 5 to 25 millions in North and South Bihar; and from 10 to 51 millions in Bengal—an extraordinary total increase of 35 to 125 millions in four centuries in the Ganges Valley leading to some of the world's highest records of rural aggregation. The Dacca Division, Eastern Bengal, has a mean density of 935, and in

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[1] Quoted in Shirras: *Poverty and Kindred Economic Problems in India.*

Munshiganj sub-division the extraordinary figure of 2,413 and in Lohajang no less than a 3,278 per square mile have been reached. The south-western part of Dacca, the adjoining strip in Mymensingh and another strip along the Jamuna on the west, in the same district, and the central portions of Faridpur and Bakarganj constitute a block in which the population is in no area less than 1,000 to the square mile and reaches as much as 3,275.

THE MEASURE OF OVER-POPULATION

Population pressure may, however, be better gauged by reference to crop area than to total area. East has estimated that 2·5 acres represent the minimum size of land indispensable for the support of each in agriculture under the present standards of farming efficiency.[1] We cannot accept Professor East's minimum of 2½ acres *per capita* for the nourishment of the Asiatic cultivators. In Eastern countries, food requirements are less, especially in India because of the warmth, than in Europe and America, while more than two croppings can be raised from the same area in the year in considerable parts of monsoon Asia. These advantages are, however, in some measure offset by agricultural idleness, and the loss of economy of man and animal power secured in the West. Meticulous agricultural surveys that have been carried out in various parts of India indicate that the minimum subsistence family holding here would be 4 to 6 acres. Differences in soil productivity and agricultural water-supply, crop-rotation and agricultural practice and skill of the cultivator, alter the size of the subsistence holdings.

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[1] Food and Population: *Proceedings of the World Population Conference*, p. 89.

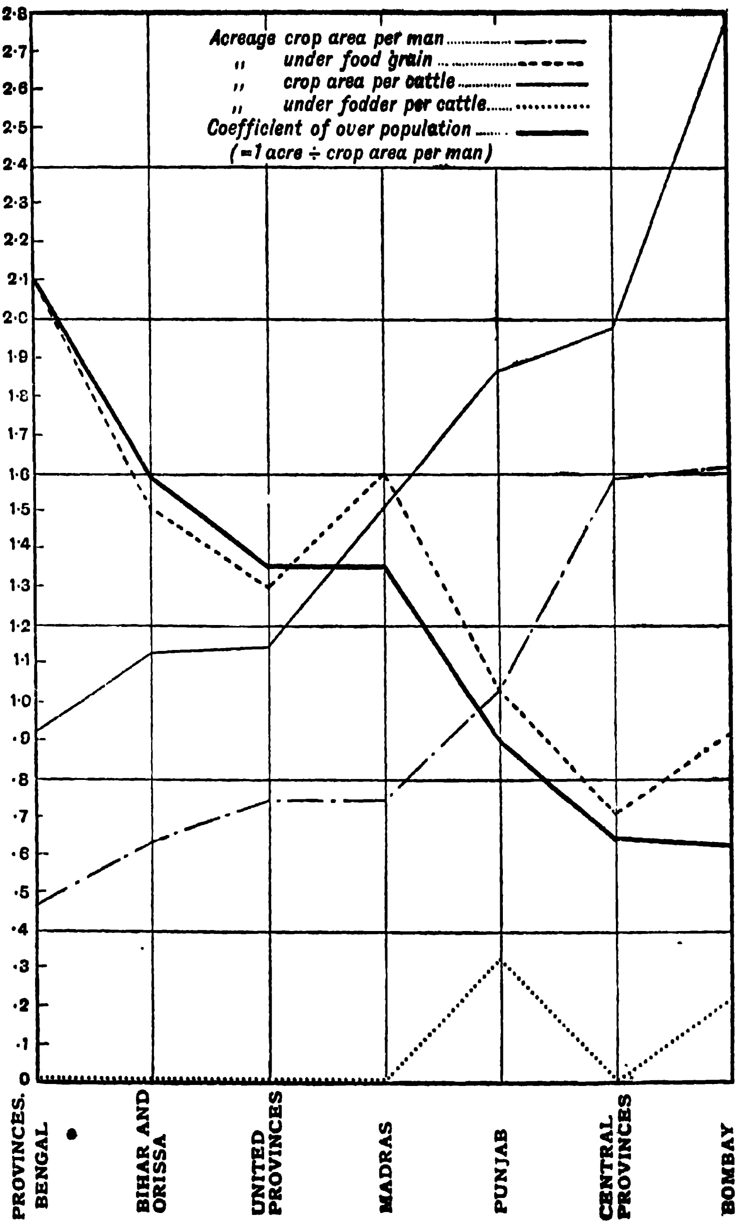

FIG. 2.—OVER-POPULATION, HUMAN AND BOVINE

For the whole of India 5 acres could be fairly accepted as a fixed point round which the argument for saturation can centre. Improvement of agricultural methods, migration and industrialisation make the subsistence holding somewhat of an abstraction, but such an abstraction has its uses in the economics of both changing and stationary worlds. In China, Buck estimates that the best family-sized farm is 3·51 hectares, i.e., 8·6 acres. But this is not the minimum economic unit. Accepting 5 acres as the subsistence family holding for the eastern countries we reach 1 acre of land *per capita* as indispensable for the nourishment of man, 4·2 and 5·4 persons being the average size of the family in India and China respectively.

The relative co-efficients of over-population in the West and monsoon Asia could be compiled by dividing 2·25 and 1 acre respectively by the crop area *per capita* of the country.

RELATIVE OVER-POPULATION IN THE ORIENTAL COUNTRIES.

	Population (Millions)	*Crop Area*		*Relative Co-efficients of Over-population (East's Standard)*	*Relative Co-efficient of Over-population (Revised)*
		(Million Acres)	*Acres per Capita*		
Japan	66·3	23·9	0·36	6·94	2·8
China	450	208	0·44	5·1	2·3
India	375	298·1	0·78	2·8	1·3
U.S.S.R.	165	700	4·2	0·59	0·24
United States	125·0	413·2	3·3	0·77	0·30
Canada	10·3	300	28·9	0·08	0·03

No doubt an exclusive dependence on agriculture spells misery for teeming millions in the East where the saturation point, so far as food supply from local cultivation is concerned, has been reached. The following table gives the total population and density for men and animals along with cultivated areas and coefficients of saturation for the major Provinces in India.

Province	*Population in Millions*	*Density per Square Mile*	*Population of Live-stock in Millions*	*Number of Cattle per 100 Acres of Crop Area*	*Crop Area (Million Acres)*	*Crop Area per capita in Acres*	*Co-efficient of Over-Population*
Bengal	50·1	646	31·4	108	23	0·47	2·1
Bihar and Orissa	37·6	454	28·3	89	24	0·63	1·58
United Provinces	48·4	456	41	88	36	0·74	1·35
Madras	46·7	328	42·9	66	34	0·74	1·35
Punjab	23·5	238	23·6	54	26	1·12	0·89
C.P.	15·5	155	14·5	51	24·5	1·58	0·63
Bombay	21·9	177	18·8	36	33	1·61	0·62

THE LAW OF DIMINISHING RETURNS

With a rapid population increase, the total percentages of cultivated to cultivable area have now reached the phenomenal figures of 75 to 95 per cent in the Ganges Valley. Densities of cultivation and population in many districts of the Ganges plain are extraordinary. In the following table the relative co-efficients of over-population have been worked out for those districts of the valley where the percentage of net cultivated to cultivable area has exceeded 80:

	District	*Density per square Mile*	*Percentage of Net Cultivated to Cultivable Area*	*Crop Area per capita*	*Co-efficient of Over-population*
United Provinces	Saharanpur	489	81	0·82	1·2
	Bareilly	679	84	0·71	1·3
	Meerut	699	83	0·68	1·4
	Bulandshahr	595	81	0·78	1·2
	Aligarh	602	87	0·78	1·2
	Gorakhpur	787	85	0·61	1·6
	Basti	737	82	0·63	1·6
	Benares	930	83	0·49	2·1
	Ballia	742	82	0·6	1·6
Bihar	Muzaffarpur	969	82	0·50	2
	Darbhanga	946	88	0·46	2·17
	Shahabad	456	88	0·90	1·1
	Patna	795	87	0·44	2·27
Bengal	Dacca	1,265	95	0·41	2·4
	Mymensingh	823	85	0·43	2·3
	Faridpur	1,003	91	0·51	2·0
	Bakarganj	834	90	0·64	1·6
	Tippera	1,197	96	0·35	2·8
	Noakhali	1,124	92	0·43	2·3

Forests, meadows and marshes, all are now invaded by the plough due to population increase, which also leads to the scarcity of fodder and grazing grounds. The population of grazing animals comprises about 500 per square mile, considerable numbers of which are inefficient and worn out cattle but are maintained in compliance with Hindu religious sentiment. A chronic fodder deficiency is responsible for both lack of vigour of the ox and low milk yield of the cow which have such unfavourable reactions on farming efficiency.

Due to population increase holdings have been fragmented into tiny bits. In the United Provinces it has been estimated by the Banking Enquiry Committee that the majority of the holdings are uneconomic, i.e., below 5 acres, which are the minimum necessary for maintaining a peasant's family. Thirty per cent of all cultivators of the United Provinces are living below the economic level, and cannot even in the best of years make ends meet. Another 52 per cent are living at or just above the economic level, making ends meet in a good year but not in a bad one. Continuous fractionalisation of holdings restrains the small cultivator not only from adopting improved appliances and methods of cultivation and constructing wells, but also even from intensive farming. Thus two important methods of increasing the food supply will be inaccessible to small-holders as the population pressure becomes heavier. In the United Provinces during the last ten years the percentage of double-cropped to cultivated area has actually diminished; the decrease being 6 and 9 per cent in the plain, Central and East respectively. In Jaunpur district, the double-cropped area of which is one of the largest in the United Provinces, that double-cropped area has diminished from 192,000 to 152,000 acres between 1918 and 1933. Even in a prosperous district like Meerut the percentage of double-cropped area to the net cultivated area diminished from 32·8, as the average for 1914–18, to 28·3 as the average for 1927–1933. The chief cause of such reduction is the Malthusian Law of Diminishing Returns. Formerly the larger holding could be given the much needed rest. Intensive farming in fractionalised plots has now meant such haste, imperfect tillage and robbery of the soil, especially in the case of adoption of the more exhausting sugar-cane or cotton crops, that the total returns diminish. The peasant is responding to the law of diminishing returns by curtailing his double-cropped area, although this means a still lower standard of farming and living. In the more crowded districts in the United Provinces, Bihar and Bengal, which have reached the limits of extension of agriculture, the expansion of double-cropped areas has also slackened in recent years. The United Provinces and Bengal in 1931 had 3 millions more each and Bihar 4·3 millions more mouths to feed than in 1921. In the United Provinces the average net cultivated area of the years 1928–1933 was 35,180,933 acres as compared with 35,299,486 acres in the years 1920–1925. There has also been a diminution of the double-cropped area in the whole province by about 6 lakhs acres. In Bihar the average net area sown during the years 1928–1933 diminished by 742,220 acres when compared with the average of the years 1920–1925. "Nor can it be asserted," observes the Census Superintendent, "that the yield per acre of land has increased to any extent by new and improved methods of exploitation." Similarly, Bengal's net cultivated area has slightly decreased during the last decade. It was 23,527,200 acres on an average between 1920–1925. In the years 1928–1933 it stood at 23,514,440 acres. In 1935 it stood at a still lower figure, 22,674,000 acres. Except in Assam, Burma and Sind a high percentage of available cultivated area has been brought under the plough, ranging from 65 per cent in Bihar and Orissa to 86 per cent in Bombay.

UNRECLAIMED LAND

The chances of expansion of cultivation have now been exhausted, at least in the major provinces, hills, sand-dunes and uncultivable wastes now thwarting extension.

	Percentage of Net Cultivable Area	*Cropped Area to Culturable Waste*	*Percentage of Net Cropped Area to Current Fallow*
Bombay	65	4	27
Bengal	67	22	22
Bihar and Orissa	64·9	26	21
Agra and Oudh	71·7	28	10
Madras	60·4	34	27
Punjab	66	66	17
Assam	22	248	45
Sind	—	158	142

The area of forests cannot be given over to the plough in the major Provinces; it is already too small in relation to the cultivated area. A further diminution will affect unfavourably the quantity and distribution of rainfall, cause floods and endanger agriculture.

	Area in Square Miles	*Crop Area in Million Acres*	*Area of Reserved Forests and Lands in Square Miles*	*Percentage of Column 3 to Column 2*
Bengal	76,755	23	10,529	21
Bihar and Orissa	82,936	24	2,780	7·4
United Provinces	106,720	36	5,228	9·3
Madras	143,290	34	19,340	36·4
Punjab	97,281	26	6,695	16·4
Central Provinces	99.927	24·5	19,677	51·4
Bombay	123,125	33·0	12,292	23·7

In the crowded river valleys of Northern India, there is now little room for expansion of cultivation. Settled conditions have long been established, permitting the extensions of the frontiers of cultivation into the forest and marsh, ravine-stricken jungle and sand-dune. The possibilities of large canal irrigation schemes have been almost exhausted. Much of new uncultivated areas can no longer be brought under the plough as a result of the construction of new canal systems. The Malthusian Law of Diminishing Returns is now operating not only by the soil but also by water acting as a limiting agent in agricultural development. In the United Provinces the limits of the flow irrigation have been nearly approached and in the future the Province will have to work more and more towards hydro-electric lift irrigation from tube-wells or low-level canals or rivers. It will have to utilise the sub-soil water reservoir to a greater extent than before. But even here the limits of well irrigation have been reached in some areas. A few of the eastern districts recorded phenomenally high percentages of 90 to 95 per cent of well irrigated to the total irrigable area in the last famine year, 1918. In the dryest zone in the United Provinces, the Muttra-Etawah region, little expansion of well irrigation is possible, due to the rapid fall of the sub-soil water level that is now putting too great a strain on the muscles of cattle and men, leading to a steady deterioration of agriculture. Throughout the plains of India a striking change of hydrographical conditions is indirectly brought about by deforestation in the hill slopes and over-grazing, especially in the riverine areas. In the United Provinces the encroachment of sands and ravines on arable lands on the flanks of the Jumna, Chambal, Ganges and other rivers has seriously aggravated the maladjustment between population and food supply. In these Provinces alone the amount of ravine lands, formed as the result of soil erosion and excessive drainage has been estimated at about 8 million acres. *Usar* lands formed as the result of water-logging, shallow tillage and defective soil aëration represent another 5 million acres in the United Provinces alone. On the other hand, water-logged, miasmatic wastes expanding in North Bihar and Bengal are swallowing up what were once prosperous agricultural areas, threatening about two-fifths of the latter province with decay and ruin.

The Balance of Population

Sündbarg's age categories, though these have to be revised in their application to the balance of population in India, apply with singular exactitude at the present Census to his conception of a typically progressive population. All the Provinces except Madras, United Provinces, and Bombay show a heavy piling up in the first and second age-groups. It is expected that the populations of the Provinces of the Punjab, Bengal, Bihar and Orissa and the Central Provinces will increase at an accelerated space in the coming years. As between the Hindus and the Mohammedans in India the latter show more satisfactory biological conditions and will increase in numbers more rapidly.

	Number per Mille Aged		
	0-15	15–50	50 *and over*
Progressive	400	500	100
Stationary	330	500	170
Retrogressive	200	500	300
India	399	505	96
Japan (1925)	367	482	151

Province	*Number per Mille Aged*		
Progressive	0-15	15-50	50 *and over*
1. Punjab	412	481	107
2. Bengal	408	511	81
3. Bihar and Orissa	402	502	96
4. Central Provinces and Berar	401	500	99
Stationary			
1. Bombay	397	512	91
2. United Provinces	389	513	98
3. Madras	389	505	106
Community			
1. Hindu	392	509	99
2. Muslim	422	493	85

As a matter of fact in the whole of India the number of children aged 0 to 10 to each married woman aged 15 to 40 is greater amongst the Muslims, as given below.

Hindu	1·64
Muslim	1·78

Persons of an advanced age are more numerous in the Punjab and Madras than in other Provinces. In Bengal there is a higher proportion of children, but malaria does not permit long life. The span of life is here shorter and the number of persons aged 50 and over is in consequence abnormally low, in fact lowest in the whole of India; although Bengal stands high among the Provinces as a progressive type of population.

That the population in every Province will still continue to multiply is indicated clearly not merely by applying Sündbarg's categories but also by the proportionate increase of the number of married females aged 15 to 40 in almost all the Provinces of India.

	Number of Married Females aged 15–40 per 100 Females of all Ages		
	1911	1921	1931
1. Bengal	34	34	36
2. Bihar and Orissa	33	33	35
3. Bombay	35	33	36
4. Central Provinces and Berar	36	32	36
5. Madras	32	32	33
6. Punjab	34	32	33
7. United Provinces	35	34	36

During these three decades the average number of years lived by a woman in the reproductive period increased as follows: 12·25 in 1901, 12·05 in 1911 and 13·91 in 1931, according to an estimate made by Raja.[1] Such a tendency will also contribute to accelerate population growth in India. Specific mortality rates for both males and females for the period 1921–33 show that the trend of mortality is downward for all age-groups, except that of "60 years and upward" in the case of both sexes. Thus the fall of mortality is real, and the death-rate is not likely to rise unless the country falls a victim to an abnormal epidemic. The trend of the vital index also indicates the probable future increase of population. The vital index was 134·6 in 1921–30 (average). The vital indices for the following years were 137·7 in 1931; 156·0 in 1932; 158·4 in 1933; 135·3 in 1934 and 147·8 in 1935. The index exceeds by 47 per cent on an average (1931–35) the measure for stationary population. Further statistical analysis yielded by two separate processes 402 and 400 millions as the estimated population of India in 1941. This would represent an increase of 13 per cent during the present intercensal period as compared with 12 per cent increase during the period 1931–35, and 10·6 per cent increase during 1921–1931. Provided, therefore, no abnormal epidemic or famine visits the land, the population of India is likely to reach 400 millions in 1941.

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[1] Raja: Probable Trend of Population Growth in India, *Indian Journal of Medical Research*, July, 1935; also his paper read before the First Indian Population Conference, Lucknow, and the discussions that followed on the forecast of population in India.

CHAPTER II

POPULATION CAPACITY

TRENDS OF POPULATION AND FOOD SUPPLY

Over-population can best be estimated from a survey of the food position of the country over a number of years. We shall here consider the trend of food-production, in respect of both quality and quantity, in relation to population increase. In the following four tables we have examined India's increase of population in relation to her agricultural production and food supply for the period 1910–1911 to 1934–1935. The appendices at the end of the chapter give the actual data on which the index numbers of food supply have been worked out and indicate also the methods of preparation of the various index numbers.

TABLE 1

MOVEMENT OF POPULATION IN INDIA FOR THE PERIOD 1910–1911 TO 1934–1935

The estimates have been worked out on the basis of survival rates for the years 1910 to 1920. Hutton's figures for the inter-censal years have been taken for 1922 to 1933. The Public Health Commissioner's figures have been taken for the recent years.

The quinquennial average for 1910–1914 is taken as the base.

Year	*Population in Millions*	*Total Cropped Area (Million Acres)*	*Area under Food Grains (Million Acres)*
1910–11	314·4		
1911–12	315·1		
1912–13	312·3		
1913–14	315·7		
1914–15	319·5		
Average	315·4	251·8	223·3
1915–16	323·0	252	228
1916–17	325·9	263	237
1917–18	328·8	261	235
1918–19	331·4	230	201
1919–20	315·4	283	247
1920–21	313·6	266	229
1921–22	314·6	286	253
1922–23	318·9	289	253
1923–24	319·0	286	243
1924–25	319·0	291	247
1925–26	319·4	290	242
1926–27	319·7	291	245
1927–28	321·0	289	244
1928–29	323·0	295	249
1929–30	327·3	295	248
1930–31	335·8	299	254
1931–32	352·8	299	258
1932–33	367·0	298	253
1933–34	372·0	303	259
1934–35	377·0	295	251

TABLE II

INDEX NUMBERS OF POPULATION AND CULTIVATED AREA IN INDIA

(1910–1911 TO 1914–1915) BASE=100

	Population	*Total Cropped Area*	*Area under Food Grains*
Average of Five Years 1910–11 to 1914–15	100 (315·4 Millions)	100 (251·8 Million Acres)	100 (223·3 Million Acres)
1915–16	103	100·0	102·2
1916–17	104	104·3	106·2
1917–18	104	103·5	105·3
1918–19	105	91·2	90·1
1919–20	100	112·3	110·7
1920–21	99	105·5	102·6

TABLE II—(*Contd.*)

	Population	*Total Cropped Area*	*Area under Food Grains*
Average of Five Years 1910–11 to 1914–15	100 (315·4 Millions)	100 (251·8 Million Acres)	100 (223·3 Million Acres)
1921–22	100	113·4	113·4
1922–23	101	114·6	113·4
1923–24	101	113·4	108·9
1924–25	101	115·4	110·7
1925–26	101	115·0	108·5
1926–27	102	115·4	109·8
1927–28	102	114·6	109·4
1928–29	103	117·0	111·6
1929–30	104	117·0	111·2
1930–31	107	118·6	113·9
1931–32	114	118·6	115·6
1932–33	117	118·2	113·4
1933–34	118	120·3	115·9
1934–35	120	117·2	112·4

TABLE III

INDEX NUMBERS OF POPULATION AND VOLUME OF CROP PRODUCTION IN INDIA

	Population	*All Crops*	*Food Crops*	*Non-food Crops*
Average of Five Years 1910–11 to 1914–15	100	100	100	100
1915–16	103	123	131	115
1916–17	104	122	133	111
1917–18	104	125	131	119
1918–19	105	104	95	114
1919–20	100	107	132	83
1920–21	99	105	102	109
1921–22	100	109	125	94
1922–23	101	119	139	100
1923–24	101	120	127	113
1924–25	101	117	119	116
1925–26	101	127	123	132
1926–27	102	118	129	107
1927–28	102	132	124	139
1928–29	103	138	123	154
1929–30	104	146	127	166
1930–31	107	145	131	160
1931–32	114	149	133	166
1932–33	117	127	134	121

TABLE IV

INDEX NUMBERS OF VARIATION OF POPULATION AND FOOD SUPPLY IN INDIA

	Population	*Food Production Weighted*	*Food Supply available for Consumption (Unweighted)*	*Excess or Deficit of Food Supply Index in Relation to Population Index*
Average of Five Years 1910–11 to 1914–15 (base)	100	100	100	
1915–16	103	129	125	+22
1916–17	104	135	126	+22
1917–18	104	130	122	+18
1918–19	105	91	87	−18
1919–20	100	130	113	+13
1920–21	99	99	99	0
1921–22	100	127	120	+20
1922–23	101	144	125	+24
1923–24	101	129	109	+ 8
1924–25	101	121	103	+ 2
1925–26	101	121	113	+12
1926–27	102	126	117	+15
1927–28	102	117	111	+ 9
1928–29	103	118	120	+17
1929–30	104	123	122	+18
1930–31	107	126	123	+16
1931–32	114	126	122	+ 8
1932–33	117	124	123	+ 6
1933–34	118	123	122	+ 4
1934–35	120	125	123	+ 3

Weights are assigned according to protein values (see Appendix II, p. 33). Food supply available for consumption is computed after deducting exports, seeds amounting roughly to 1 million tons per every 200 million acres of food grains and 10 per cent wastage ,and adding imports of sugar and cereals (see Appendix I, pp. 31, 32).

DETERIORATION OF THE FOOD POSITION

We find from the above tables that though the rate of growth of the total cropped area has just gone ahead of the rate of population increase, the area under food crops in particular has definitely lagged behind. It is true that on the whole, the increase of total agricultural production has outstripped population growth, but the margin is less

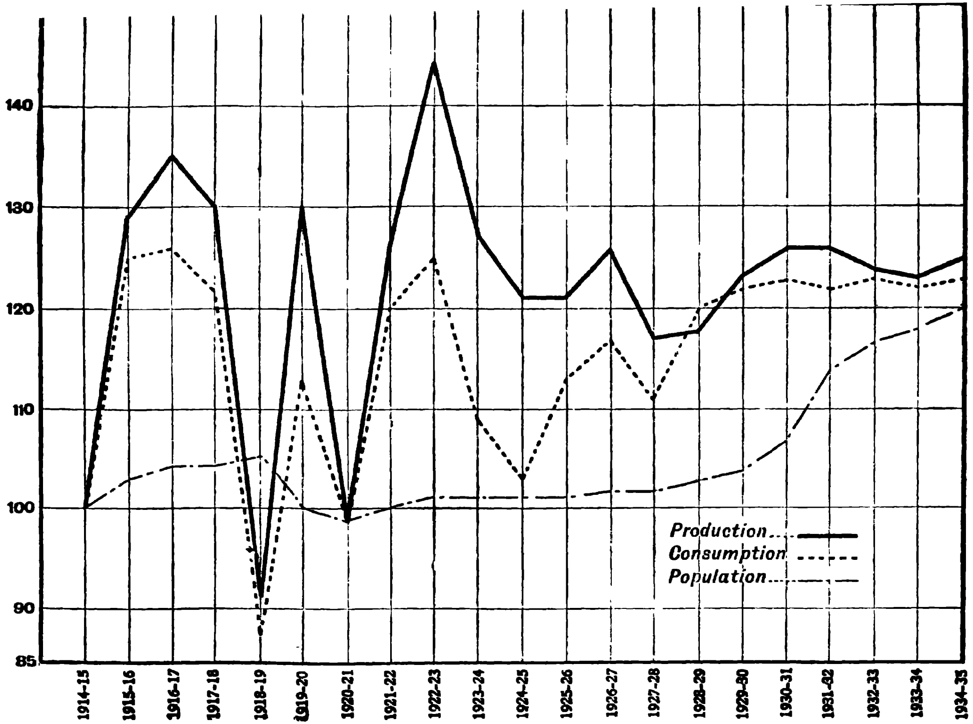

FIG. 3.—MOVEMENT OF INDEX NUMBERS OF FOOD PRODUCTION, AVAILABLE FOOD SUPPLY AND POPULATION

in the case of aggregate food production—only 4 per cent, which is further reduced to 2·5 when we consider the food supply actually available for consumption. The difference between the indices for population and food supply is gradually becoming narrower, and this indicates a deterioration of the food position.

The danger inherent in the deterioration of the food position is offset in some measure by the tendency of the exports of food crops gradually to diminish. The present agricultural depression and the rapid industrialisation of the Orient will, however, counteract any tendency for the exports to be changed over to net food imports purchased by such cash crops as cotton, jute, hemp and groundnuts—though these latter have expanded sufficiently rapidly along with the inferior cereals to keep the rate of growth of total agricultural production in excess of the rate of growth of the population. Secondly, our index numbers show that there has been a continuous increase of the production of the inferior food grains, at the cost of rice and wheat, during the last thirty years, which is a tendency ominous for the general food position. The following table gives the index numbers of production of the chief cereals between 1910–1935:

RELATIVE EXPANSION OF THE LESS NUTRITIVE CEREALS

	Index Numbers of the Output for each Quinquennium					*Variation Percentage*
Superior Cereals	1910–15	1915–20	1920–25	1925–30	1930–35	1910–35
Rice	100	114·0	108·4	107·2	110·2	+ 10·2
Wheat	100	96·2	93·4	93·0	97·8	− 2·2
Inferior Cereals						
Jowar	100	157·4	167·0	210·8	207·8	+107·8
Barley	100	224·2	202·6	172·2	173·4	+ 73·4
Bajra	100	114·0	105·0	126·0	125·0	+ 25·0
Maize	100	114·0	100·0	106·0	112·0	+ 12·0

In our estimate of food production (see Appendix) we have included sugar, which is not a staple food, and the recent expansion of sugar-cane cultivation has pitched up the food index numbers to rather a high point. The increase of food production is due chiefly to the phenomenal expansion of sugar-cane, barley and jowar. The production of rice, the cereal of about two-thirds of the population, increased in 1935 by only 6 per cent while the production of wheat has shown a somewhat steady decrease since 1924–1925. Barley, jowar, maize and gram have, on the other hand, leaped up in production, jowar having more than doubled in total output (108 per cent increase). The increases in the cases of barley, maize and bajra are 73 per cent, 12 per cent and 25 per cent respectively. In the Indian population situation what is, however, more significant than the relative proportions of increase of population and food production is the absolute heavy population pressure. Such pressure implies a chronic food shortage which is aggravated by the droughts and famines, periodically recurrent every six years in considerable parts of India.

It is accordingly clearly evident that the food position of India is gradually becoming worse both with reference to the relative proportion of food production to mouths to feed and also with reference to the nutritive quality of the cereals. The excess of available food-supply index over population index was on the whole oscillating round about 20 till the end of the last decade. For the last four years there has been a gradual and significant decline, and the tendency appears for the margin to disappear altogether.

RICE AND WHEAT PRODUCTION AND CONSUMPTION

Between 1932 and 1933, the production of both rice and wheat declined, this being due to the agricultural depression, which has rendered cereal cultivation unremunerative in many areas in small-holdings. The fall in rice production amounted to 1,912,000 tons in 1932 and 736,000 tons in 1933, as compared with 1931–1932. Such fall in rice production is exceedingly significant since this cereal is by far the most important foodstuff for large sections of population in India. Burma produces from 7 to 8 million tons of rice and provides on an average about 3½ million tons to supply the needs of the rest of India. This development of rice as a commercial crop, which in fact places Burma in the first rank among rice exporting countries, is due to the great natural facilities for irrigated cultivation, together with the low density of population (under 60 per square mile) as compared with the dense populations of the three great rice-growing Provinces—Bengal, Madras, and Bihar and Orissa. In Bengal there is a deficit of 125,000 tons of rice per annum; in Bihar it is about 80,000 tons, while in the United Provinces the deficit may be as much as 400,000 tons. Such deficit is made up by imports, chiefly from Burma.[1] In 1933–1934 the production of rice was estimated at 30·8 million tons and it decreased to 30·2 in 1934–1935. Similarly the wheat production declined by 182,000 in 1932 but increased by 425,000 tons in the next year. In 1933–1934 wheat production was estimated at 9·4 million tons and it increased to 9·7 million tons in 1934–1935. The recent increase of wheat production, largely due to the development of the large irrigation works in Sind, would mean greater internal consumption as the surplus wheat has ceased to be exported. Save for the expansion in Sind, there are now no important increases of wheat areas in the different provinces, the acreage being that associated with a favourable sowing season. On the whole, even taking into account the diminution of exports of agricultural produce, the food available per head for consumption has declined. The total wheat requirement of India is estimated at 9·5 million tons. This was not available in three out of five years, 1930 to 1935, while it must be remembered that drought years, which recur about every six years in Northern India, lead to a large reduction of wheat production even with normal acreage of the crop.

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[1] *Crop Planning Conference, Resumé of Discussions*, p. 5.

ESTIMATE OF FOOD SHORTAGE

By using Lusk's co-efficients of comparison of the food requirements of children with those of an average man or a woman, we estimate "the average and total man value" of India's population of 1931 in the following table. The proportion of children and adults to the total population is as follows in India: 39·9 (0—15 years); 50·5 (15—50 years) and 9·6 (50 years and over).

Ages	*Population in Millions* (1931)	*"Man Value" per head*	*Total "Man Value" in Millions*
0–153 (9 per cent)	141·2	0·7	98·84
Males 15 and upward	109·2	1·0	109·20
Females 15 and upward	102·6	0·83	85·15
	353·0	0·835	293·19

Allowing 2,800 calories per man per day, the total requirement of the Indian population would amount to approximately 292 billion calories per annum. The aggregate food supply available for consumption in India in 1931 was 60·1 million tons. Estimated on the basis of 100 calories per ounce per average Indian food grain, 60·1 million tons would yield 215·4 billion calories. The total number of calories necessary for rice and wheat-eaters in India may roughly be fixed at 2,400 and 3,000 calories respectively. The aggregate number of rice and wheat-eating people may be estimated at 240 and 100 millions respectively. Comparing the proportions of rice and wheat-eating people, Province by Province, we find that the weighted average number of caloric requirements for the whole of India would be 2,600; 2,800 calories would represent the daily gross *per capita* food requirement, which would allow 200 calories for wastage during distribution, in the kitchen and at the table (or on the floor). India's total milk production from 51 million cows and 420 million cow-buffaloes may be estimated at 113,000 million pounds, which give an approximate caloric value of 34 billions. To this we have also to add India's total fish supply, which is very roughly estimated at 700,000 tons. This would yield ·7 billion calories. The amount of energy contributed annually to Indian food requirements from all sources is accordingly 250·1 billion calories as compared with our minimum need of 292 billion calories. The total caloric value would give a daily ration of 2,337 calories per "average man" in India. An addition must be made to this figure for the caloric value of garden produce, which cannot be determined accurately even for Great Britain. The average consumption, however, falls short of the Indian standard food requirement of 2,800 calories. The average energy consumption per head for the Western countries is much higher, 3,400 to 3,600 calories. Nothing shows our food shortage more clearly. To put it differently, India's population capacity was 291 million persons on the basis of the conditions of agriculture and food supply at the time of the last Census.

Between 1931 and 1935 British India added about 2 million acres under food crops. In the absence of recent figures for the States and Agencies, we assume the same rate of increase for these as well. This would increase the total food supply of India by about 4.2 billion calories. From India's home production of sugar (6·2 million tons) and import (223,000 tons) we obtain an additional supply of 26·1 billion calories. India's total output of calories from all food sources would thus be 280·4 billions. Between 1931 and 1935 India has, however, increased her population by 20 millions, yet in 1931 our food shortage amounted already to 41·9 billion calories. The "man value" of India's present population (1935) is estimated as follows:

Ages	*Population in Millions*	*"Man Value" Per Head*	*Total "Man Value" in Millions*
0–15	150·8	0·7	105·56
Males of 15 and upward	125·5	1·0	125·5
Females of 15 and upward	100·7	0·83	83·58
	377	0·8	314·6

It may, therefore, be concluded that India has now fallen short of food for 48 millions of her average men, provided that agricultural seasons are normal, and droughts and floods do not occur. The conclusions may be tabulated as follows:—

1.	India's population in 1931	353 millions
2.	India's population capacity on the basis of her food supply in 1931	291 million
3.	India's food shortage in 1931	42 billion calories
4.	India's present population 1935	377 millions
5.	India's addition to food supply between 1931 and 1935	30·3 billion calories
6.	India's present food supply	280·4 billion calories
7.	India's present food needs	321·5 billion calories
8.	India's present population capacity 1935 ..	329 millions
9.	India's present food shortage	41·1 billion calories
10	Present number of "average men" estimated without food assuming that others obtain their normal daily ration	48 millions

Estimate of Population Capacity

India's total waste lands which are available for cultivation, but not taken up and abandoned, in the different Provinces, States and Agencies, excluding the current fallow which is necessary to maintain soil fertility in her present stage of farming, amount roughly to 162 millions of acres. Of waste lands in British India about 40 per cent are in Burma, 12 per cent in Assam and 9 per cent each in the Punjab, the Central Provinces and Madras. Of the total 162 million acres about three fourths, or 122 millions, may ultimately be sown with food grains under an unremitting population pressure. This might give about 29 million tons of food-grains from which 103·9 billion calories may be ultimately available. Under a most complete expansion of cultivation, which will not be possible without the adoption of vast measures of land reclamation and irrigation and the strenuous efforts and practices characteristic of the Chinese peasantry, India's total population capacity cannot be above 447 millions of persons. From 1871 to 1935 the population of India increased from 206 millions to 377 millions and threatens to number 400 millions before long. Between 1931 and 1935 about 24 millions have been added to the population of India on the estimate of the Public Health Commissioner.

Immediately after 1921 the present population capacity of India was overstepped, and by the middle of the century, assuming that the present real increase continues, India will in all probability overstep 447 millions, her ultimate population capacity under the existing farming and living standards and industrial conditions of the people.

It has been suggested that since India is progressing industrially, cultivated or even culturable area should not form the real basis of estimates of her population capacity. Such hope is based on several misconceptions as regards India's economic advance.

INDEX NUMBER OF VALUE WEIGHTS FOR PRODUCTION OF PRINCIPAL INDUSTRIES IN INDIA

The base period is 1910–1911 to 1914–1915. Figures given in D. B. Meek's article on Indian External Trade, *Journal of the Royal Society of Arts*, 1936, have been utilised.

1910–11 to 1914–15	100		
1896–97	48	1915–16	121
1897–98	52	1916–17	122
1898–99	54	1917–18	119
1899–1900	56	1918–19	111
1900–01	50	1919–20	117
1901–02	64	1920–21	119
1902–03	66	1921–22	113
1903–04	68	1922–23	117
1904–05	71	1923–24	117
1905–06	78	1924–25	134
1906–07	79	1925–26	133
1907–08	83	1926–27	146
1908–09	83	1927–28	153
1909–10	93	1928–29	134
1910–11	90	1929–30	158
1911–12	91	1930–31	146
1912–13	102	1931–32	156
1913–14	101	1932–33	156
1914–15	104		

It is true that India's increase of industrial and mineral production has gone much ahead in increase of numbers, the figures respectively being 17 and 56, but industrial and mineral production occupies a relatively small place in contrast with agricultural production in the economic life of India and in relation to India's population and standard of living. The relative percentages of contribution to the total national income from agriculture, industrial and mineral production are 79·8, 18·1 and 1·3 respectively. The tempo of India's industrial development is much slower than that of European countries, while it must be conceded that though there is progress of manufacturing production in certain lines there is also de-industrialisation due to decay and extinction of rural arts and handicrafts. Some Provinces, like Bengal and Madras, indeed, show a greater dependence on agriculture than in the past decades. The development of manufactures by Japan and China in the future will also restrict the markets and hence the scope of India's industrial production, the more so as population pressure in Japan and China also, is likely to become heavier than even that of India. The hope that India's increasing millions may depend on food imported from foreign countries in exchange for the products of her industries is chimerical. Further India, whence rice can possibly come in large quantities, is already a scene of struggle between the three rival oriental countries progressing simultaneously in industrial production, while wheat-growing countries are far too advanced industrially to profit by exchanging wheat or other cereals for India's manufactured products. China, though the world's leading producer of rice, cannot grow it sufficiently for her requirements, and she annually imports millions of bushels of rice from Indo-China and Burma. Similarly she also imports wheat and flour of a value about one and half times more than her imports of rice. Japan also imports large quantities of rice from Siam, Korea, Formosa and even the U.S.A. At least for the next half a century it will be difficult for India to compete in open markets with the more important manufacturing countries of the world, far less to establish a balance of account in her favour which might result in the importation of foodstuffs. The future population adjustment thus seems to lie more in the directions of a judicious combination of food and industrial cropping than in subsistence farming, more in agricultural than in general industrialisation, and, above all, more in the restriction of numbers than in the diversification of employment.

APPENDICES

The figures for cropped areas and outputs of food grains year by year are obtained from the Agricultural Statistics of British India and the Indian States.[1] From the aggregate output deductions for exports, for seed grains (amounting roughly to one million ton per every 200 million acres of food grains) and for wastage (amounting roughly to 10 percent. of food production) are made to compute the total amount of food supply actually available for human consumption.

The surplus stock carried from the preceding year may increase the total output in small measure but this may not be necessarily available for immediate consumption. Speculation is often responsible for withholding stocks from the markets. Estimates of stocks, however, have not been made in India.

Index numbers of the volume of food production have been prepared by combining the various index numbers of production for each food crop (expressed on a basis of the five years 1910–11 to 1914–15) and giving to each weights, which are proportional to the protein values of the different crops. The proteins values are derived from estimates by McCarrison and the U.S.A. Department of Agriculture. To sugar cane which yields only carbohydrates and is not a staple is assigned no weight.

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[1] Vide also D. B. Meek's paper on "Indian External Trade" read before the Indian Section of the Royal Society of Arts, April, 1936. Meek disregards several cheaper food grains which are widely consumed in different parts of India. Our table includes these.

APPENDIX I

FOOD SUPPLY IN INDIA

Average output in successive years. All quantities are in million tons.

Crop	*Weight assigned*	1910–15 (base period)	1915–16	1916–17	1917–18	1918–19	1919–20	1920–21	1921–22	1922–23	1923–24
Rice	8	28·3	32·9	35·0	35·9	24·3	32·3	28·0	33·0	33·7	28·1
Wheat	14	9·6	8·5	10·2	9·9	7·5	10·1	6·7	9·8	9·9	9·7
Barley	11	1·4	3·1	3·3	3·3	2·8	3·2	2·5	3·1	3·1	2·9
Jowar	8	3·1	6·0	5·1	4·1	3·4	5·6	3·7	5·0	6·3	5·3
Bajra	10	2·0	2·3	2·9	2·1	1·3	2·8	1·9	1·8	2·4	2·2
Maize	8	2·0	2·5	2·3	2·4	1·7	2·5	2·0	2·4	1·9	2·1
Gram	21	3·2	3·4	4·2	4·4	1·9	3·7	2·3	4·3	5·2	4·5
Sugar cane	0	2·4	2·6	2·7	3·4	2·4	3·0	2·4	2·5	3·4	3·3
Ragi	10	3·4	4·3	3·2	3·3	3·0	3·5	3·3	3·2	3·2	3·2
Other food grains ..	10	13·6	15·2	14·2	14·7	11·5	10·3	13·1	14·3	14·0	14·0
Weighted Index No. for total output of food grains (as above)		**100**	**129**	**135**	**130**	**91**	**130**	**99**	**127**	**144**	**127**
Add for											
Import of Sugar ..		0·9	0·6	0·5	0·5	0·5	0·5	0·3	0·8	0·5	0·5
„ „ Cereals ..		..	..	..	..	..	..	..	..	..	..
Deduct for											
Exports		– 4·4	– 2·4	– 3·0	– 4·5	– 3·2	– 0·9	– 1·5	– 1·7	– 2·6	– 3·4
Seeds		–11·2	–11·0	–12·0	–12·0	–10·0	–15·0	–11·0	–13·0	–13·0	–12·0
Wastage 10 per cent ..		– 5·3	– 6·7	– 6·8	– 6·7	– 4·6	– 6·1	– 5·3	– 6·5	– 6·7	– 6·0
Net food supply available for consumption		49·0	61·3	61·8	59·6	42·5	55·5	48·4	59·0	61·1	53·4
Index No. for net available food supply		**100**	**125**	**126**	**122**	**87**	**113**	**99**	**120**	**125**	**109**

Crop	1924–25	1925–26	1926–27	1927–28	1928–29	1929–30	1930–31	1931–32	1932–33	1933–34	1934–35
Rice	31·0	30·7	29·7	28·2	32·2	31·1	32·2	32·2	31·1	30·8	30·1
Wheat	8·8	8·7	9·0	7·8	8·6	10·5	9·3	9·0	9·5	9·4	9·7
Barley	2·6	2·6	2·6	2·1	2·5	2·3	2·4	2·4	2·4	2·4	2·5
Jowar	5·8	5·7	6·0	7·0	6·9	7·0	7·0	6·2	6·5	6·2	6·3
Bajra	2·2	2·3	2·8	2·6	2·6	2·3	2·6	2·7	2·6	2·1	2·5
Maize	1·6	1·9	2·0	2·3	2·0	2·4	2·4	2·3	2·1	2·1	2·3
Gram	4·1	3·9	4·0	3·2	2·7	3·1	3·4	3·8	3·5	3·8	3·7
Sugar cane	2·5	3·0	3·3	3·2	2·7	2·8	3·2	4·0	4·7	4·9	5·1
Ragi	3·2	3·2	3·3	3·2	3·2	3·4	3·4	3·4	3·3	3·3*	3·3*
Other food grains ..	14·0	14·0	14·7	14·7	14·7	15·1	15·2	15·4	15·6	15·6*	15·6*
Weighted Index No. for total output of food grains (as above)	121	121	126	117	118	123	126	126	124	123	125
Add for											
Import of Sugar	0·7	0·8	0·9	1·0	0·9	1·0	1·2	0·6	0·4	0·3	0·2
,, ,, Cereals	..	..	..	..	0·7	0·4	..	0·2	0·1	0·1	0·4
Deduct for											
Exports	– 4·2	– 3·0	– 2·4	–12·2	– 2·3	– 2·5	– 2·6	– 2·6	– 2·1	– 1·8	– 1·8
Seeds	–15·0	–12·1	–12·3	– 2·8	–12·5	–12·4	–12·7	–12·9	–12·7	–12·7*	–12·7*
Wastage 10 per cent	– 5·7	– 6·1	– 6·2	– 6·0	– 6·3	– 6·6	– 6·6	– 6·6	– 6·7	– 6·7	– 6·7
Net food supply available for consumption	50·6	55·6	57·4	54·3	58·6	59·9	60·4	60·1	60·3	59·8	60·5
Index No. for net available food supply	103	113	117	111	120	122	123	122	123	122	123

(* These figures have been deduced.)

APPENDIX II

Food Value of Cereals per oz. According to Protein Contents.

	Grams
Rice	2·31
Wheat	3·9
Barley	2·97
Jowar	2·25
Bajra	2·78
Maize	2·13
Gram	5·70
Sugar Cane	·00
Ragi	2·78
Other food grains	2·75

CHAPTER III

THE MALTHUSIAN CHECKS

SOCIAL EFFECTS OF POPULATION PRESSURE

There are certain obvious effects of over-population. The economic effects of over-population are uneconomic or undersized holdings, which prevent the adoption of improved methods of cultivation, lead to the abolition of fallowing, and hence to soil depletion. The general costs of cultivation are thus raised, and in particular the proportionate amount of labour done by men and bullocks is increased. A low yield per unit of labour, agricultural idleness or unemployment and inadequate subsistence are linked with one another in a vicious circle. Migration and the combination of small farming with agricultural labour, small craft or carting, mitigate the overcrowding in agriculture. But in the absence of a rapid industrialisation these fail to draw off the surplus population from the land adequately. On the other hand, the increase of a landless class, due to the overcrowding in agriculture cheapens labour relatively to capital and not only delays the introduction of improved agricultural tools and implements, but also the adoption of measures of housing reform, and also protective and ameliorative measures in respect of industrial labour, which might increase labour efficiency and quicken the pace of industrialisation. The social effects of over-population are pauperism, vagrancy and theft. In

India there is a striking correspondence between the conditions of the harvests and crime, especially that against property. The moral effects of over-population are a natural indifference, despondency and even fatalism, which destroy the desire or the will to live better.

THE TOLL OF LIFE FROM FAMINE

The biological effects of over-population in India have been a direct correspondence of birth-rate and an inverse correspondence of death-rate with favourable harvests, and a gradual "ecologic" adjustment of natality and mortality so that an equilibrium density or an average abundance is reached. These were the unclassified Malthusian "positive" checks of population, which are now operating over large areas in India in a somewhat modified manner. Up till the end of the last century severe famines, which were recurrent, contributed to limit normal growth of numbers and establish an equilibrium density. The mortality from famines during the last century has been estimated as follows by Digby, Lely and others:—

Period.	*Number of famines.*	*Estimated mortality.*
1800–1825	5	1,000,000
1825–1850	2	400,000
1850–1875	6	5,000,000
1875–1900	18	26,000,000

Thus during the last century the total toll of life on this account was represented by the figure of 32·4 millions. In the famine of 1901, the worst of recent years, one million people perished. The loss of life in British Districts was 3 per cent of the population affected as against 33 per cent in the

Bengal famine of 1770, when ten million persons perished. Famines seem to recur in India at intervals which have been found to correspond with sunspot minima and maxima. Droughts occur in the Peninsula or the South-west, one or two years preceding the sunspot minima. In years of sunspot minima, droughts occur in the Indo-Gangetic basin and are severer in the Western and Central portions; while during one or two years following the sunspot maxima droughts recur both in Northern India and the Peninsula. Thus Indian droughts appear frequently in pairs, leading to an appreciable decrease of birth-rate and increase of mortality. Every six or twelve years the annual scarcity widens its area and becomes a recognised famine. At intervals of several decades whole provinces are involved and population increase is checked. Famines have now lost their rigour, due to improvement of means of communications, and farming practices, facilities of irrigation and rural credit, migration and industrialisation. A severe drought, however, is even now followed by dysentery and diarrhœa due to unwholesome and insufficient food or reduced powers of digestion and assimilation as the result of privation. The incidence of mortality from famine or scarcity diseases has not yet been investigated. The increase in mortality in areas which have just been under the grips of scarcity, from diseases like dysentery, diarrhœa and fever as well as from wasting and deficiency diseases, needs enquiry. The Report of the Famine Commissioners (1901) abundantly shows that mortality due to privation is followed by further rise in mortality due to cholera, diarrhœa and fever, owing to the reduced power of the people to resist infections. Attention should also be drawn to the mortality among different social strata and the factor of malnutrition as causing predisposition, and death from ordinary endemic diseases. Finally, the study of population trend indicates an abnormal increase in the birth-rates usually following a famine or scarcity period.

MOVEMENT OF POPULATION DURING AND AFTER FAMINES

Province	*Famine year*	*Variation of population per cent*		
		1881–91	1891–01	1901–11
Bombay	1876–77	+15	−6	
	1899–1901		−6	+6
Madras	1876–77	+15·7		
Mysore	1897			+18·1
Central Provinces and Berar	1896–99			+17·9

THE TOLL OF EPIDEMICS

Epidemic diseases, however, still continue to play their important rôle in checking population growth. The trend of increase in this century, especially after the famine of 1900–1901, received a temporary check from the influenza epidemic which affected 125 millions and killed off 12 to 13 millions between 1918 and 1919. The following estimates of the mortality in India from the chief epidemic diseases during 1901 and 1931 have been made: cholera 10·75 millions; influenza (1918–1919) 14 millions; plague (since its appearance in 1896) 12·5 millions; and malaria 30 millions.[1] Between 1922 and 1931, out of a total mortality of 6,270,662 (mean) in British India fevers were responsible for 3,703,459 deaths. The incidence of mortality from other diseases is as follows: small-pox 74,064;

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[1] Russell and Raja: "The Population Problem in India," *Indian Journal of Medical Research*, October, 1935.

plague 129,057; dysentery and diarrhœa 224,450; cholera 225,187; respiratory diseases 358,559.[1] In 1933, the latest year for which figures are available, the mortality from the main epidemic diseases, cholera, plague and smallpox, was 214,500, smallpox levying a toll of 103,000, and plague one of 43,000. Fevers caused a mortality of 3½ millions, of which malaria is estimated to have exacted a toll of a million. Lt.-Colonel Sinton observes: "In ordinary years, malaria is responsible directly for at least 1,000,000 deaths each year, and, in years when severe regional epidemics occur, this figure may be increased by another quarter to half a million. The fatal effects of the disease fall chiefly on children and infants. The local distribution of the mortality may be markedly increased by conditions of economic stress. There seems little doubt that malaria, by its combined direct and indirect actions, is responsible for at least 2,000,000 deaths each year in India." The number of persons who suffer annually from malaria is estimated at not less than 50 millions; it may easily exceed 100 millions in some years. It is estimated that a death from malaria involves from 2,000 to 4,000 sick days. Estimating the earning capacity of such persons at Rs. 10 per mensem, and accepting 2,000 sick days for each mortality, the total economic loss to India from malaria, apart from mortality, is Rs. 10,600 millions. In Bengal alone, where at least 60,000 out of 86,618 villages are malaria-stricken, malaria levies an annual toll of from 250,000 to 350,000. In the United Provinces the mortality is even greater, 625,000 to 932,000. The average for the 10 years 1926–1935 is 770,477.

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[1] *Annual Report of the Public Health Commissioner*, 1931.

MEASUREMENT OF VITAL TREND

Pearl has effectively used the vital index (100 $\frac{\text{births}}{\text{deaths}}$) to measure the biological health of a population and to indicate its probable future course. If the ratio of 100 births/deaths is greater than 100 the population is in a growing and, in so far, a healthy condition. If it is less than 100 the population is biologically unhealthy. Kuczynski's methods of measuring vital trends, through the calculation of gross and net reproduction rates, are much more exact than Pearl's. Since in India no records are kept of the age of the mother at the time of child-births, such rates cannot, however, be worked out, and we have to depend upon the calculations based on the vital indices for measuring the vitality of populations. The following table of vital indices of some congested districts of the United Provinces, where the saturation density might be considered to have been reached in 1901, indicates the damage done by epidemics to these populations, which is much severer than elsewhere, and also a recuperation of biological vigour as shown by high vital indices immediately following epidemic years. It is rather significant that the populations show a strong predisposition to epidemics and a striking recuperation in years of abundant harvests.

Districts		*Net Variation, %* 1881–1931	*Vital Indices before the Year of Saturation Density*				*Vital Indices in the Years of Epidemics Outbursts*		
			1881	1886	1891	1896	1905	1908	1918
Agra	..	+ 7·6	145·5	100	165	133	52	54	79
Aligarh	..	+14·7	180	96	143	150	92	52	31
Cawnpore	..	+ 2·6	106	109	92	121	86	86	42
Etawah	..	+ 3·3	126	92	110	155	118	62	43
Lucknow	..	+13·0	125	121	99	113	75	59	44
Muttra	..	− 0·5	138	90	136	147	36	39	28

	Vital Indices after the Year of Saturation Density								
	1901	1906	1911	1916	1921	1923	1930	1933	1935
Agra ..	142	94	98	161	108	143	162	174	165
Aligarh ..	153	121	90	185	105	138	155	180	137
Cawnpore	126	63	94	155	84	130	123	159	144
Etawah ..	150	75	93	161	88	132	146	186	158
Lucknow ..	113	103	93	196	97	152	92	121	146
Muttra ..	118	98	98	189	116	123	112	181	141

SIX-YEARLY VITAL AND METEOROLOGICAL CYCLES

Further, even in normal years free from epidemic outbursts, we see in the first instance a close correspondence between an abundance of harvests and a high birth-rate and low mortality and shrinkage of harvests and high death-rate and low natality. A high birth-rate tends to be followed by high mortality, though a high death-rate tends to be followed also by a low birth-rate. Secondly, rainfall, harvests and birth and death-rates all show six-yearly cycles, and are fairly synchronous with the phases of sunspot activity.[1] Such automatic ecological checks of population are different from the epidemic outbursts like that of the influenza pandemic of 1918, which carried off 20 lakhs of people in the United Provinces and 107½ lakhs in the whole of British India, and which succeed storms of breeding as among gregarious animal populations. For in the case of the human population Nature's mechanisms work more slowly, systematically and indirectly, the Malthusian balance being reached by a steady lowering of birth-rate and a predisposition of epidemics.

DECREASE OF BIRTH-RATE AND LONGEVITY

It is true that in the whole of British India the birth-rate does not show a definite downward trend.

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[1] Mukerjee: "Agricultural Cycles and Sunspots," *Indian Journal of Economics*, 1933.

The birth-rate in 1933, though somewhat higher than in the previous two years, has merely returned to the average level recorded during the 33 years of the present century, and according to the Public Health Commissioner the slight reductions recorded during 1931 and 1932 seem to have been merely fortuitous in character and cannot be taken to indicate that there is any tendency for the Indian people to follow the example of Western nations in respect of restriction of families. Yet in the heavily populated provinces, United Provinces, Bihar and Orissa, and Bengal, there has been a steady decline of birth-rate during the last 30 years, which the Census Superintendents or the Public Health Directors find difficult to account for, apart from the inaccuracy of statistics. The figures are given as below:—

FALL OF BIRTH-RATE IN THE UNITED PROVINCES, BIHAR, AND BENGAL

Year	*United Provinces*	*Bihar and Orissa*	*Bengal*
1901–1910	41·4	41·0	35·5
1911–1920	42·3	39·0	32·5
1921–1930	35·1	36·5	28·5
1929–1933	36·0	34·0	27·0
–1934	35·0	32·0	29·0
–1935	34	33	32

Intensive study of vital statistics over a period of 60 years in certain congested districts in the United Provinces also indicates that there is a distinct tendency towards diminution of birth-rate after a district's saturation density is over-stepped. For instance in Jaunpur the average birth-rate was 36 per thousand between 1901 and 1911; it came down to 28 between 1919 and 1927. In 1932 it stood at 26·4. Between 1928 and 1932 the birth-rates remained stationary at 28. Such diminution of birth-rate is not due to human volition at all. It resembles the tendency of decrease of birth-rate and longevity, found by Pearl and Swinney in the case of fruit-flies when these overstep an average abundance, but is probably brought about through malnutrition and diminution of hormone output and nervous activity due to economic pressure.

In the West, where the Malthusian theory has been applied to explain vital statistics, a negative correlation of the birth-rate with wealth has been found, but since nowhere has there been such close race between population and food supply, as in the Oriental countries, the indirect physiological and psychological effect of lack of food on birth and death-rates can best be studied here. As the result of a questionnaire sent to physicians working in typical agricultural villages throughout India, and replies received from 571 among them, Sir John Megaw found that malnutrition due to unsuitable diet was the rule rather than the exception. The average amount of milk consumed by each person worked out at about 3½ ounces daily; nourishing proteins and vitamins were obviously insufficient in the majority of cases. The United Provinces peasants' substitution of millets and cheap food grains for wheat, milk and vegetables, with their adequacy of Vitamin E, in drought years, may lower fertility apart from its unfavourable effects upon vitality and resistance. Some epidemics of disease again, which attack particularly women of the child-bearing age and bring down their number, may also temporarily lower the birth-rate and alter the age-and-sex-distribution for a long period, to the ultimate detriment of birth-rate.

Due to an improvement in the means of communications, in economic organisation and in thrift and general level of intelligence, famines, it is true, no longer kill people. But the absence of an agricultural surplus, swept away by increased numbers, and malnutrition affecting especially children and women, indirectly lead to a shrinkage in the birth-rate through an alteration of the age-and-sex-distribution of the population.

Thinning out of the Young and the Old

Changes in age-distribution for a long period are a valuable guide in India as to finding out in what particular manner economic conditions assert themselves in respect of the different sections of the population.

VARIATION IN POPULATION AT CERTAIN AGE-PERIODS

Period	*Variation per cent in Population (Increase) (Decrease)*					
	All ages	0–10	10–15	15–40	40–60	60 *and over*
United Provinces						
1881–1891	+ 6·34	+10·18	− 0·35	+ 5·49	+ 6·11	+ 9·13
1891–1901	+ 1·68	− 3·22	+12·21	+ 1·62	− 4·45	− 3·78
1901–1911	− 1·07	− 1·28	− 4·12	+ 0·71	+ 1·74	− 3·15
1911–1921	− 3·1	− 0·3	− 3·7	− 5·5	− 2·1	− 0·3
1921–1931	+ 6·7	+12·4	+ 7·2	+11·2	− 3·7	−21·7
Bihar and Orissa						
1881–1891	+ 6·4	+ 3·4	+18·0	+ 5·2	+ 7·0	+ 7·9
1891–1901	+ 1·1	− 3·4	+ 1·4	+ 5·2	+ 0·3	− 1·9
1901–1911	+ 3·5	+ 6·6	+ 0·3	+ 3·5	+ 0·7	+ 2·7
1911–1921	− 1·2	− 5·5	+ 4·9	− 0·8	+ 2·8	− 5·5
1921–1931	+11·5	+14·8	+ 8·2	+14·6	+ 7·9	−12·2
Bengal						
1881–1891	+ 7·5	+ 9·6	+11·5	+ 7·9	+ 3·2	− 1·6
1891–1901	+ 7·7	+ 6·8	+15·1	+ 9·4	+ 6·7	+ 1·2
1901–1911	+ 8·0	+ 9·3	+ 5·8	+10·1	+ 3·6	+ 0·9
1911–1921	+ 2·8	− 1·2	+ 8·3	+ 5·3	+ 2·5	− 5·9
1921–1931	+ 7·3	+ 8·8	+10·7	+ 8·9	+ 3·5	−14·6

It will appear that except in the last decade, due to absence of economic catastrophies and severe epidemics of disease, there is a tendency to decrease of the proportion of the very young, while the proportion of the very old shows Census by Census a more marked diminution, due to the selective incidence of agricultural scarcity and epidemics. The influence of droughts and famines in the earlier decades left its mark on the adolescent groups as well, until 1921, particularly in the United Provinces. Such factors as migration, inaccuracy in returns and alteration in the method of grouping, are responsible for anomalies, but the dominant tendency as regards the thinning out of the young and the old is clearly discernible. Economic privations affect persons at the extremes of life more than persons in middle age, men more than women, while in drought years the numbers of births diminishes, the proportion of children to the total population being accordingly reduced. For both Bombay and the United Provinces the legacy of past famines was the dominant factor in the age constitution in the last decade, even overshadowing the selective mortality of the influenza epidemic.[1]

DECREASE OF THE PROPORTIONS OF WOMEN OF THE REPRODUCTIVE AGE AND OF WOMEN TO MEN

A state of chronic food shortage, punctuated by spells of unfavourable seasons, particularly affects the very young and old, also women, especially those in the child-bearing age, when the ancient practices of infanticide, abortion and abstinence from intercourse have been largely discarded. The results of this are high infantile and maternal mortality. During the last decade the infant mortality rate in India ranged about 170 and 180 per mille, as compared with about one-third of this figure in England in recent years. Half the number of deaths in a year take place under 10 years and 45 per cent under 5 years of age. It was estimated in 1931 that the infantile death-rate in India was following a downward trend after the disastrous years of 1918 and 1919. But the recorded rates of the past six years seem to indicate that that trend has disappeared. Since 1928, in fact, the annual figures for infant mortality have fluctuated only slightly between 181 per 1,000 births in 1930 and 169 in 1932, and the figure for 1933 again lies between these two contiguous limits.[1] Death of young mothers at child-birth is also a common occurrence in India. A special enquiry set on foot in Madras by Russell disclosed the maternal mortality-rate as 20 per 1,000 live births, though the figure in the Public Health Commissioner's Report showed only 5·3. This rate of 20 per mille may be contrasted with the rate of 2·6 in the Netherlands or 6·5 per mille in the United States of America. Megaw estimates that 100 out of every 1,000 girl wives are doomed to die in child-birth before they have ceased to have babies, and 200,000 mothers die in giving birth to children every year in India. The Age of Consent Committee observes that there is "a large element of truth in the theory that the frequency of birth has a very direct bearing on maternal and infant mortality"; that "according to the medical evidence the effect of frequency of births at short intervals is far more disastrous when maternity starts at an early age" and that proportionate to the high maternal and child mortality "there is a vast number of invalids and physical wrecks among the survivals." More frequent than the death of young mothers in India is death of women in the later period of maternity, say, between the years of 20 and 30, brought on by the physical exhaustion, nervous breakdown and other ailments which are the aftermath of premature child-bearing.[1]

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[1] For Bombay, see Sedgwick: *Census Report of the Bombay Presidency* 1921, and Marten: *Census Report of India*, 1921, p. 130.

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[1] *Report of the Public Health Commissioner, Government of India,* 1933.

The reduction of the number of women at the reproduction period, worn out by a long struggle with food deficiency and by frequent child-bearing, is one of the demological causes of the slackening of the birth-rate in the heavily congested plains of India. Since 1901 there has been a steady diminution in the proportion of females to males in India. "The female infant," observes Hutton, "is definitely better equipped by nature for survival than the male, but in India the advantage she has at birth is probably neutralised in infancy by comparative neglect and in adolescence by the strain of bearing children too early and too often." Frequent child-bearing, when the majority of the Indian females are living on a sub-nutritional level, largely explains the large and increasing disparity of sex-proportions. Comparing male and female in vital statistics in the United Provinces it has been found that there is much higher mortality of the females at the reproductive ages and that the conditions have become worse since 1921, leading to a rise of the sex-ratio in deaths.

The violent fluctuations in both birth-and-death rates, in close correspondence with harvest conditions noticed in many parts of India, represent accordingly an unhealthy demological symptom, indicating not only the absence of an agricultural surplus but also the vulnerability of population, due to overstepping an equilibrium density. Reproductive powers may also be directly impaired in the case of the lower economic strata as a result of chronic malnutrition or deprivation of certain essential elements, such as calcium and vitamins in wheat, which is superseded by millets, and in milk and vegetables discarded in unfavourable years. A general loss of physiological vigour due to malnutrition affects menstruation, leads to an increase of abortion and hence contributes to lower fecundity. Apart from causing a decline of fertility, malnutrition has selective effects on mortality, raising infantile and maternal mortality and lowering the proportion of infants and mothers in the community. Provinces and districts which suffer from droughts and famines show a distinct fall of the ratios of children and of females at the reproductive ages to adults. This again contributes towards a long-run decline of the birth-rate. Finally, in India a decline of the female ratio, which is the result of several biological, economic and social causes, stabilises the trend of decline of birth-rate. Among some castes and communities the steady fall of the female ratio is due, apart from the effects of climate, diet and race, to the association of early and too frequent maternity and deliberate or forced neglect of female children with malnutrition. A variety of biological and racial factors contributes directly and indirectly to lower fertility and alters the age-and-sex distribution of the community in a manner leading to the long-run fall of birth-rate. These are analysable and not "immutable forces of Nature," as assumed in Pearl's somewhat mystical hypothesis.

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[1] Vide the *Census Report of Travancore State*, where, however, the condition of wives and mothers is more favourable than in most parts of India.

That birth-rate declines if the population continues for long above its average abundance, together with diminution of resistance to epidemics, was not anticipated by Malthus, though this is the best evidence of the reality of the Malthusian positive checks in India, even though war, epidemic and famine no longer scourge back population to a suitable or equilibrium density as before. The annual average death-rate has been amazingly reduced in the United Provinces and Bihar from 40 and 37 to 26 per mille between 1921 and 1931, but such reduction is due to the absence of epidemics of disease, which will now, it is expected, raise a heavier toll than before, due to lower resistance of the populations. In Bengal, also, the average death-rate of 31·1 for 1911–1920 was reduced to 25·3 for 1921–1930. But this, again, is due to absence of a serious epidemic, the population being also accustomed to the scourge of malaria.

THE LOW EXPECTATION OF LIFE.

The expectation of life is now considered as a suitable criterion for optimum density. Actuarial examination indicates that on the whole during the last 50 years the expectation enjoyed by both males and females in India does not show an uninterrupted increase as in most countries in the world. In Bengal and the Punjab the enjoyed expectation for females has actually declined.

COMPARATIVE EXPECTATION OF LIFE AT BIRTH IN INDIA, BENGAL, UNITED PROVINCES AND ENGLAND FOR MALES (M) AND FEMALES (F)

	1881		1891		1901	
	M.	F.	M.	F.	M	F.
India	23·67	25·58	24·59	25·54	23·63	23·96
United Provinces	23·10	24·94	24·45	25·25	25·30	23·93
Punjab	24·80	26·85	26·58	27·62	23·18	—
Bengal	24·50	26·51	22·78	23·73	21·57	22·51
England ..	—	—	—	—	44·07	47·70

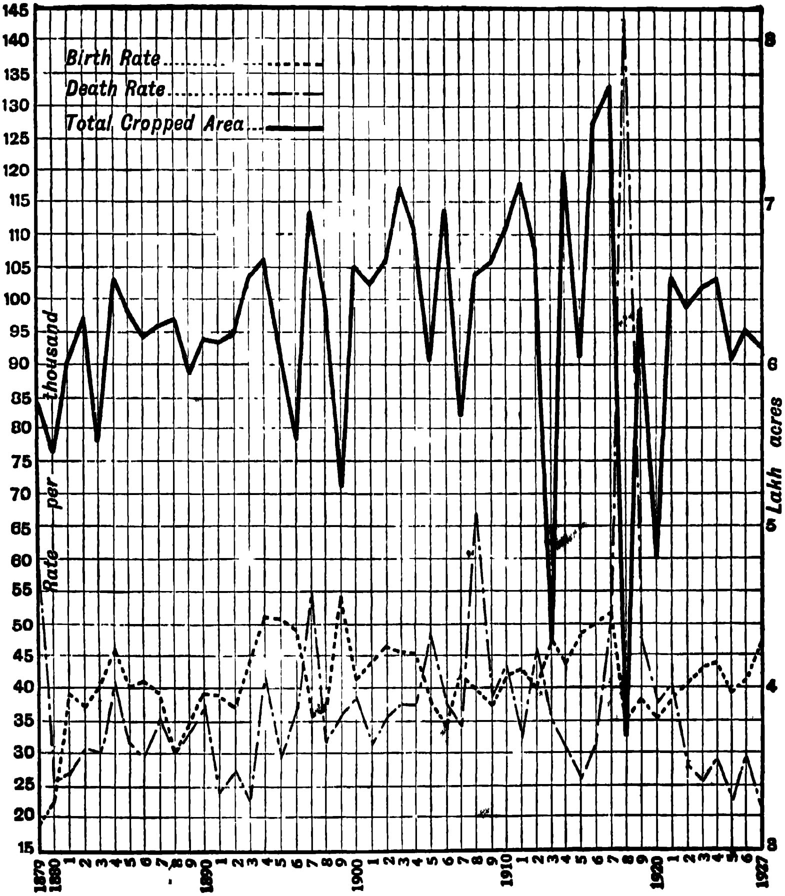

FIG. 4.—RELATION BETWEEN HARVESTS AND VITAL STATISTICS IN AGRA DISTRICT, UNITED PROVINCES

	1911		1921		1931	
	M.	F.	M.	F.	M.	F.
India	22·59	23·31			26·91	26·56
United Provinces	21·21	21·50			24·56	25·09
Punjab	21·23	—			28·05	26·57
Bengal	21·47	21·58			24·91	24·80
England ..	46·04	50·02	55·62	59·58	—	—

In Australia in a period of 35½ years the expectation of life for men increased 12 years, and that for women 12½ years. In Germany, Great Britain, Norway, Holland and Switzerland the expectation of life at birth for men is about 55. In New Zealand life-span has reached 62 years. "India with an expectation of life of 23 years" (now increased to 26½ years), observes Ross, "is a bench mark from which ascent can be measured."

AVERAGE EXPECTATION OF MALE LIVES IN INDIA AND ENGLAND

Age	*India*	*England*
0	26·91	55·62
10	36·38	44·64
20	29·57	45·78
30	23·60	37·40
40	18·60	29·19
50	14·31	21·36

In every civilised country the span of life is lengthening. Many health workers are confident that before the close of the twentieth century the normal life in some Western countries may span the biblical three score and ten. The exceedingly low expectation of life in India and the decrease of female longevity in some Provinces are the inevitable effects of excessive numbers and heavy wear and tear which is aggravated by infant marriage and frequent child-bearing from a relatively early age.

FERTILITY RATES IN DIFFERENT PROVINCES

The higher mortality of the women in the reproductive age, as well as the larger proportion of widows, bring down the net reproduction rate for India. Out of 1,000 females born only 483 and 238 reach the ages of 15 and 45 respectively. Less than a quarter of the women, therefore, pass through the cycle of reproduction. Further, 16 per cent of the women of the reproductive age in India are widows and do not bear children.[1] In England and Wales only 8 per cent of the females are widows, and some of these do re-marry. There are 940 females (all ages) to 1,000 males in India—one of the lowest sex ratios in the world. But the proportion of females aged 15 to 45 to males aged 20 to 50, which is more significant in respect of immediate multiplication of population is higher. The point at which the number of females is adequate to the number of males is, however, limited to the ages from 15 to 30, and it is probable that their deficiency from the ages of 30 to 60 is due to exhaustion as the result of early and frequent child-bearing. The average number of children born alive for every married woman is 4, of which 2·9 survive. Thus every married woman contributes 2·9 children. For a stable population, one mother must replace herself, and for an increasing population she must contribute more than one female to the population. Taking the proportion of male to female births viz. 108 to 100, every such marriage would contribute about 1·9 girls, out of whom 1·37 would be found surviving.

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[1] Vide P. M. Lad's chapter on the "Balance of Births and Deaths" in *Economic Problems of Modern India* and his remarks on my paper read before the East India Association; also the Census Report 1931, pp. 200 and 210.

High female death-rate during earlier years, widowhood and high maternal mortality, particularly in the early reproductive ages, diminish the chances of child-bearing. In spite of all these factors we have a phenomenally high fertility rate in the country, and this seems to be on the increase in some Provinces. In 1931 the fertility rate in Bihar and Orissa, for instance, was 151 per 1,000 married women aged 15 to 45. In 1933 the general fertility increased to 169 per 1,000 of females of ages 15 to 40. Since the percentage of married females in this age group is about 85, the nuptial fertility rate reaches about 200 for 1933. The nuptial fertility rate in England and Wales was 176 and in Japan was 245, as compared with 151 in Bihar and Orissa and 139 in Bengal in 1921. In the Punjab a special enquiry into marriage and fertility has revealed a higher nuptial fertility rate in 1931 than in Bengal, and even higher than in Bihar and Orissa, the figure being 224 and slightly lower than in Japan. But there is a large infant mortality. Out of 224 children born 178 survive to be included in the population. Fertility data from all Provinces are not available, but the Bihar and Punjab fertility rates are an eye-opener. On an average we get one child per each married woman for every five years in the Punjab, where early marriages are also quite common. A group of 100 women married below the age of 12 have an average 366 children born to them, but only 271 survive; so that every wife has on an average lost one child. On the whole, wives married below 12 have a higher proportion of children surviving than those married at higher ages. This is a physiological puzzle, which has to be explained on the basis of more data. The following table gives the proportion of children to married females, aged 15 to 40, in some Provinces:—

NUMBER OF CHILDREN UNDER 10 PER 100 MARRIED FEMALES

Province	1911	1921	1931
Punjab	—	199	193
United Provinces ..	150	161	161
Bihar and Orissa ..	170	167	163
Bengal	181	172	170
Madras	165	160	163
Bombay	159	174	165
Central Provinces and Berar	160	180	156

On the whole, in the Punjab not merely is the fertility rate higher, but the effect of infant mortality is also less apparent than in other Provinces. In most Provinces of India the progressive rise in child population in the last three decades is due not to any rise in the nuptial fertility, but to a greater degree of survival due to raising the age of marriage for women, the multiplication of facilities for rural medical relief and improvement of nutrition, and of the attitude of the people in respect of child care.

There is a very wide prevalence of the practice of infant and disparate marriages in India, the effects of which on net reproduction rate have not been adequately studied. As the age of the wife rises, fertility decreases but the "effective fertility" increases. But this is not always true. In Travancore, fertility rises with the postponement of marriage but not the proportion of surviving children. On the other hand, it appears that the Punjabi women married early have on an average a larger number of children born to them. Their nuptial fertility rate is higher. Baroda statistics, however, indicate that if the age of the girl marriage is changed from 13 or 14 up to 20 the rate of fertility and the rate of survival are both substantially raised. Climate, race and nutrition in the Punjab may partly account for this higher survival rate of children born to young wives. It also appears that the parity of ages of husband and wife is found to give not only the highest fertility but also the greatest number of children. In Scotland professional and other skilled occupations showed in 1911 a low rate of fertility, while agriculture, mining and labour were among groups of high fertility. The Punjab Census in 1921 showed that the artisans had the highest fertility rate and clerics the lowest. A fertility enquiry in Oudh revealed that groups representing sedentary and slothful occupations ruled the highest rate of fertility and then came the agricultural labourers. The Baroda enquiry shows that agriculture rules a relatively low-sized family but with a high ratio of survival; general and agrestic labour shows, on the other hand, as in other parts of the world, a high average of children. That harder economic life makes child-bearing difficult, and also indirectly contributes to shorten the duration of married life seem to be indicated by the lower fertility rates of the backward and depressed classes than in the case of the advanced groups in Bombay Presidency. This does not hold good, however, of the major portion of India, where on the whole the less advanced stocks are breeding faster than the advanced stocks. The absolute fertility of the less advanced social groups is greater but poverty and hard life lower the survival value of their children. Climate, race, social customs and economic conditions are all implicated in the determination of absolute and effective fertility and the net reproduction rate in India and each factor has to be carefully analysed and weighed by sociologists, region by region and caste by caste.

CHAPTER IV

FOOD STANDARDS AND FOOD VALUES

COMPARISON OF FOOD CONSUMPTION IN TROPICAL AND TEMPERATE REGIONS

It has been observed that differences of climate affect the food requirements of workers. Maurel estimates that the number of calories necessary for a male adult weighing 55 kilograms and performing light work varies from 1,650 in hot seasons in warm regions to 2,740 in cold seasons in cold regions.[1] Work has been done in India and Japan on the basis of 2,000 calories as compared with 5,000 which was the British war ration, and 3,300 which is estimated to be the average requirement of a Britisher engaged in sedentary pursuits.

Much depends also upon the general standard of physical measurement. The food requirement of an average Euro-American is based on the average body weight of 70 kilograms (154 lbs.). In India we have to base our calculations on an average weight of 47·3 kgs. (104 lbs.). The average weight of the Chinese is 55 kgs., and of the Japanese and Javanese 51 kgs. Professor Morimoto estimates that a Japanese may be fairly expected to consume only 80 per cent of what a foreigner needs, for the average weight of a Japanese is only 13 kwan, 830 momme, to the European's 17 kwan, 20 momme.

[1] *Proceedings of the World Population Conference*, p. 93.

In dietaries, nitrogen has a position of its own. We must daily take in a certain minimum quantity of the element but opinions have differed as to the exact amount of this minimum. It now appears that the minimum is not so much of nitrogen itself as of particular amino-acids of which it forms an essential part. The apparent minimum will thus vary according to the type of protein ingested and we could make it smallest by becoming cannibals.

Nitrogenous foods, next, are heating to the body and on account of this, people who live in the colder climates are accustomed to take more nitrogenous food than those in the tropics. Thus it comes about that custom gives Indian diets much less nitrogen than the European—from 50 per cent to 70 per cent less. More vegetable proteins are consumed in India than in the West. Speaking about vegetable proteins Dr. S. Wright observes that though these are rather less effective as body-builders, there are marked exceptions: "The mixed proteins of wheat or maize as found in flour or meal will maintain nitrogenous equilibrium at a fairly low level, particularly if whole grain is used and if it be supplemented by small quantities of other proteins such as those of milk."

COMPARISON OF FOOD CONSUMPTION

	Grams of Protein per Man per Day	*Calories from all Sources*
1. Standard requirement for men at moderate work in the Western countries (Atwater)	125	3,500
2. For hard work	150	4,500
3. British war ration	175	4,855
4. Average man (Royal Society Food War Committee)	100	3,390
5. Fourteen families in York (wages under 26s.) (Rowntree)	89	2,685
6. Twelve labourers' families in New York (Wilson)	101	2,905

COMPARISON OF FOOD CONSUMPTION —*contd.*

7. For light work in Japan (Oshima) ..	100	3,000
8. For hard work (Jinrikshaman) (Oshima)	158	5,050
9. Twenty middle-class families in Shantung (Adolph)	111	3,355
10. Working-class families in Peking (Tao)	76	2,595
11. 1,070 farm families in six localities in China (Buck)	112	3,461
12 Middle-class family in Bengal (Megaw, Bhattacharji and Paul)	72·4	2,837
13 Poor Mohammadan family in Bengal (Megaw, Bhattacharji and Paul) ..	76·2	2,425
14 Poor Hindu family in Bengal (Megaw, Bhattacharji and Paul)	66·1	3,066
15 Bengal prison diet (McCay)	93	3,500
16 Standard Military ration in Baroda (Mrs. A. G. Strong)	86	2,400
17 Standard Army ration in Baroda for followers (Mrs. A. G. Strong)	86	2,077
18. Vegetarian castes in Baroda (Antia and Kale)	66	2,392
19. Non-vegetarian castes in Baroda (Antia and Kale)	64·15	2,088·02
20. For muscular agricultural work in the United Provinces (Burridge)	100	2,400

Chittenden's figures of the nitrogen metabolised per kilogram of body-weight may be compared with Voit's, McCay's and Oshima's figures as follows. To these have been added figures obtained at the Physiological Laboratory, Lucknow University.

Bengalees and Ooriyas (rice diet largely)	·116–·120
Chittenden	·120–·130
Biharis and Eastern Bengalees	·140–·160
Japanese, poor classes ..	·177
Nepalese	·180–·250
Sikkim Bhutias	·250
Average European ..	·270
Tibetan and Bhutan Bhutias	·350
Nepalese Bhutias	·420[1]
Average European in India	·224 (McCay)
United Provinces peasant	·092
„ „ middle class	·140
„ „ factory hand	·100

CALORIE REQUIREMENTS IN INDIA

Since the investigations of Chittenden and Hindhede the conviction has gained ground that the number of calories which were formerly considered necessary for a good working diet was much too high. Above all, the quantity of proteins could be reduced to almost half that which was formerly considered indispensable. In Germany it was estimated during the last war that the population was over-eating to the extent of 59·7 per cent calories and 44 per cent protein. When rations in all the armies had to be restricted, the suggestions of physiologists were carried out in practice, especially among the Germans whose offensive power and resistance were not affected thereby.

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[1] Castellani and Chalmers: *Manual of Tropical Medicine*, 3rd edit., 1919, p. 100.

Burridge finds from a recent survey of the peasant's diet in the United Provinces that it gave its caloric energy as 2,400 and allowing for 10 per cent waste, as 2,160 as against 3,500 for a British workman of 67 kilogram weight working eight to nine hours per day, but the latter diet would not be suited for working in the Indian sun as is that of the Indian coolie, who is very much in the dietetic position that the non-fighting German population were during the war. He observes: "It is evident, then, that whenever it is easily possible for heat production to outstrip heat loss, work can be more safely and economically done at the expense of fats and carbohydrates, and the low nitrogen value of Indian diets has probably been determined through this factor. It may be that the virile race develops in a particular country because its climate makes a high nitrogenous exchange possible. The Indian ryot according to European standard has a low level of nutrition which may cause fatalism but may fit him better for his actual task."[1]

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[1] *Royal Commission on Agriculture*, Vol. I, Part I, Evidence, p. 157. See also his paper on "Calorie Requirements in India" presented before the First Indian Population Conference, *Journal of the Social Sciences*,

It was found out long ago that the basal metabolism of humans (ie., the heat production of the normal individual lying comfortably at rest about 12 to 15 hours after the meal) is lower in the tropical or sub-tropical regions.[1] Metabolism studies in Brazil, Jamaica, the Philippines and Australia have indicated clearly the influence of climate, temperature and humidity in establishing the level of vital activity. The basal metabolism is also influenced by the nature of the food consumed. In a warm country like India an appreciably low metabolism is accompanied by a low level of protein consumption or protein assimilation. There is established in fact a reciprocal adaptation of region, race and food, of metabolism, work and food-intake or absorption.[2] Metabolism investigations were begun for the Indians in 1926 by H. N. Mukerjee in Calcutta.[3] The Bengalee metabolism was found by him to be on the average 9 per cent below the Western standards.

A detailed investigation at the Physiological Laboratory, Lucknow University, of the basal metabolism of peasants in the United Provinces showed that the number of calories needed was about 1,200. This estimate has been reached by measurements carried out by the British Benedict Metabolism Apparatus.[4] On this basis the require-

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1936. Here also he stresses that the scientific evidence indicates that a man who can shew his ribs and muscles through his skin is better adapted to work continuously in a hot climate than the man who is sleek or fat. Both in respect of his basal requirements and in respect of his working requirements the Indian labourer has an advantage over the more heavily-built European worker.

[1] For a summary of metabolism studies on Indians, see Mason and Benedict: *Indian Journal of Medical Research*, XIX, 1931, and Krishnan and Vareed, *ibid*. January, 1932, also Leitch: *Dietetics in Warm Climates* Chapter II.

[2] Mukerjee, *Regional Sociology*, pp. 59–60.

[3] *Calcutta Medical Journal*, XX, p. 425.

[4] N. D. Banerji, *Indian Journal of Medical Research*, XIX, 229, 1931.

ments of agricultural work, as distinguished from resting requirements in India, would be about 2,000–2,500 calories. This is slightly lower than the standard of a minimum and maximum diet theoretically planned by Mrs. A. G. Strong for persons of sedentary pursuits according to which the calories are 2,562 (minimum diet) and 3,077 (maximum diet). Antia and Kale fix a standard of 2,750–3,000 calories for the agriculturists of Baroda, working on Mrs. Strong's criteria of effective consumption.[1] Major-General McCarrison has fixed his theoretical standard applicable to India at a higher level: 2,899 calories and 86·78 grammes of protein. The average basal metabolism in Northern India has been found to be 6·9 per cent below the English and American standards. A similar investigation in South India showed that the basal metabolism of men was 12 per cent and of women 16 per cent below Western standards[2] Sokhey found the metabolism of male medical students in Bombay averaging 12 per cent below the Western standards. Similarly, in a later investigation, Mukerjee and Gupta found that the metabolism of healthy Bengali men from 20 to 29 years of age averaged 13·3 per cent below the Western standards.[3]

FACTORS INFLUENCING THE BASAL METABOLISM

It has also been discovered that high temperature, and especially high humidity of the atmosphere, lowers the basal metabolism. In the West it has long been known that the basal metabolism is higher in winter than in summer. In India, however, humidity is even more important than a high temperature in reducing the metabolic rate. Thus, in weeks of high temperature and high humidity, work in the Indian factories, as anywhere else, is bound to slacken and the reduction of industrial output has a definite correlation with the lowering of the metabolic rate of the labourers.

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[1] "Food Survey of Principal Castes," Appendix V, *Baroda Census Report*, 1931.

[2] Krishnan and Vareed: "Basal Metabolism of young College Students in Madras," *Indian Journal of Medical Research*, January, 1932.

[3] Mukerjee and Gupta: *Indian Journal of Medical Research*, XVIII, 1931.

Climatic factors such as temperature and humidity, racial factors such as the size, weight and configuration of the body, as well as the amount of protein intake or protein absorption, all influence the level of vital activity of a people. Further, the basal metabolism rises and falls according to the seasons in the same region. When the worker is very low from the metabolic point of view, there are not merely lassitude, idleness and lack of zest, but the predisposition to disease also actually increases. These facts clearly indicate that the distribution of hours in factory work should be carefully regulated in some measure according to the variations of the metabolic rate of the workers through the seasons. High atmospheric temperature, coupled with a high degree of humidity, which are probably the most significant factors in reducing the basal metabolic rate of the Indian workers, should be avoided as far as practicable for long periods of strenuous industrial operations in the plains of India. Hours of work must necessarily differ according to climates, dietaries and metabolic rates.

DRAWBACKS OF THE INDIAN PEASANTS' DIETS

A certain number of peasant diets have been investigated by me from contrasted agricultural regions in Northern India. Most of the agricultural castes are vegetarian, and milk and milk products and *dal* are the chief sources of proteins. Even in the Punjab milk is given only to the very young and old, and the consumption is on the whole small. But butter-milk is freely used by all classes, except the poorest. *Ghee* is taken, often with sugar by the more well-to-do cultivators, in not inconsiderable quantities, especially during hard work in the *rabi* season. The consumption of both *ghee* and butter-milk is reduced as we reach the lower income groups, who, instead of using wheat *chapattis* liberally coated with *ghee*, or consuming a mixture of *ghee* and *shakkar* (brown sugar) and using *ghee* for all of the cooking, use much less *ghee* and supplement it by mustard or sesamum oil. As we proceed eastward along the Ganges, population pressure does not permit milk-producing animals to be maintained in large numbers. Thus dairy products become less important in the dietary, but fish, oil and root and leafy vegetables are valuable additions. Comparing the peasant diets of the western and eastern districts of the United Provinces we find that wheat and barley often do not occur in the latter, though these normally supply valuable proteins to the former. Besides, in the western districts where the dairy is a much more important industry, supplementary to agriculture, milk *ghee* and curds are generally consumed, both proteins and vitamins being added. The great disadvantage of a purely vegetarian diet, arising from its bulk, is obviated, as milk and milk products are freely used.

The difference between India and China as regards the consumption of animal foods is noteworthy. In China milk is never utilised, although it appears that the Chinese cow will yield a milk which is specially rich in fat, although deficient in quantity.[1] Mutton, pork and bacon are, however, consumed by the peasantry in small, though in larger quantities in China than in India; while both in India and China beef is only eaten by the Moslems. Throughout India, even among the Moslems, Christians and Sikhs who may use meat, it is only the solvent cultivators who consume it once a month and even less frequently. It is only during the Id Festival that the Moslems all over India use mutton and beef liberally. In China so great is the need for subsistence crops that there are no grazing grounds nor dairy industry, cattle being used primarily as draught animals. On the other hand, animals such as pigs, goats and poultry, which can subsist on bye-products of agriculture, are maintained in large numbers and supply animal proteins to the dietary. Japan consumes fish in larger quantities *per capita* than either China or India. Until recently beef was scarcely taken at all in Japan, but of late years it has come to play some part in the diet of the population, especially of the richer classes.

The following table would indicate differences in staple foods of peasants and workers in the central and eastern districts of the United Provinces:

STAPLE FOODS OF WORKERS ON A MONTHLY BASIS IN CAWNPORE, GORAKHPUR AND LUCKNOW HAVING AN INCOME ABOVE RS. 15 UP TO RS. 30

	Cawnpore		*Gorakhpur*		*Lucknow*	
	Quantity Srs. Ch.	*Amount* Rs. As. P.	*Quantity* Srs. Ch.	*Amount* Rs. As. P.	*Quantity* Srs. Ch.	*Amount* Rs. A. P.
I. Wheat	33 10	3–4–3	21 7	2– 5–2	38 1	3–15–7
II. Rice	7 13	1–5–6	16 14	2–13–3	15 0	2– 0–0
III. Bajra	19 10	1–6–1	2 6	0– 3–2	8 10	0–11–6
IV. Pulses	7 2	1–2–4	9 13	1– 6–1	16 8	1–14–3
Total		7–2–2		6–11–8		8–9–4

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[1] Buxton: *China*, p. 84.

It will be noticed that the staple food of the people at Cawnpore is wheat, but at Gorakhpur wheat and rice equally. Throughout the United Provinces, however, the lower the income group the greater is the consumption of bejhar, i.e., mixture of wheat, barley and gram in place of pure wheat. The familiar mixtures are those of wheat and barley (Gojai), wheat, barley and gram in equal parts (Tirra), wheat and gram in equal parts (Gochan). Equal parts of barley and pea, or those of barley, gram and pea, are also mixed together for making *chapattis*. Where *missi rotis* are taken, the grains are grown together. Thus in small-holdings devoted to subsistence farming wheat is grown with barley or barley and gram and vice versa. It is barely for two or three months that wheat is accordingly consumed by the small cultivators whose food mixtures depend upon solvency and the proportions of cereals grown from season to season in their tiny holdings. The following schedule of consumption of grains would be typical:

Months	*Consumption*
September to November	Rice and maize
December to April	Mixture of jowar, barley, pea and gram; or of jowar, bajra, *lobia* and maize.
May to August	Mixture of wheat and barley; or of wheat, barley and gram; or of bajra, jowar and *lobia*.

As we go down in the economic scale the proportion of barley, which is the cheapest grain, is increased in the food mixture. The deprivation of wheat, which yields more fat and more mineral constituents per 100 calories than other food grains, tends towards deficiency or unbalance in the diet, especially as the consumption of milk, *ghee*, pulses and sugar also diminishes as we proceed from the higher to the lower grade income groups. It should be noted that labourers in the cities obtain a richer and more varied diet than the peasantry. In many Bihar and Bengal diets *ghee*, milk and sugar do not occur at all. Peasants' diets throughout Northern India appear to contain relatively larger amounts of carbohydrates. Everywhere there is less use of animal proteins. In the eastern districts of the United Provinces, in Bihar and in Bengal, small fishes, good sources of protein, and sometimes Vitamin A, calcium and other inorganic elements, are consumed by the non-vegetarian castes chiefly during the rains. But animal proteins among the majority of the non-vegetarian classes are too poor in quantity. Regarding the supply of vitamins it appears that in the eastern regions the diets are poorer in Vitamins A, C and D.

The following table shows daily per head consumption of food among Cawnpore workers in comparison with the standardised United Provinces Jail diet:[1]

Articles	*Daily Food Consumption per Head (Chatak)*	*United Provinces Jail Diet*[2]	*Increase or Decrease over Jail Diet (Chatak)*
Rice	1·6	—	+1·6
Wheat	7·3	11	—3·7
Barley	—	3	—3·0
Bajra	3·5	—	+3·5
Gram	0·19	—	+0·19
Arhar dal	0·74	1	—0·26
Urd dal	0·15	—	+0·15
Other pulses	0·4	—	+0·4
Total	13·88	15·0	—1·12
Milk	0·4	—	+0·4
Ghee	0·09	—	+0·09
Salt	0·2	0·27	—0·07
Mustard oil	0·19	0·16	+0·03

Inadequacy of calories, lack of proper balance and lack of uniformity seem to be the three great alarming drawbacks of the Indian peasants' diets and these defects are rooted in the poverty of the people, the system of cropping in tiny holdings and social and religious prejudices against the acceptance of cheap animal foods like fish, goat, mutton and eggs. It is also rather striking that the peasant's family diet in one of the eastern districts which normally yields 14,600 calories, as contrasted with the normal requirements of 16,300 calories, suffers a change for the worse in winter when the total yield of the diet is reduced to 13,200 calories only. Thus the seasonal variety of food is a source of weakness due to the precarious conditions of living in winter.

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[1] S. P. Saksena's paper read at the Indian Population Conference, 1936.

[2] Alternative cereal combination is rice, 10½ chhataks, and pulse 3¾ chhataks.

ANALYSIS OF FOOD VALUES IN INDIA

It must be pointed out in this connection that the analysis of food consumption and food values is quite inadequate in India, while there is also lack of precise information relating to weights of individuals and the exact amounts of work undertaken in the fields, workshops and factories per individual. On account of differences in climate and agriculture, foods vary remarkably in different parts of India, and even in the same Province, such as the United Provinces, a contrast is evident as between the western and eastern districts. Wheat, rice, jowar, bajri and maize have different food values and the consumption of these different food grains or their combination in different proportions govern in no small measure the efficiency and strength of the peoples.

The relative values of the nutrients are given by McCarrison as follows:

Cereals	*Proteins in Grms.*	*Fats in Grms.*	*Carbo-hydrates in Grms.*	*Calories per Ounce*
Wheat	3·90	0·54	20·35	102
Rice	2·30	0·085	22·30	99
Barley	2·97	0·62	20·60	100
Bajra	2·78	0·46	23·35	109
Maize	2·13	0·48	20·80	96
Ragi or Bajri	2·78	0·46	23·35	109
Cambu	3·64	1·38	19·40	105
Cholam	2·90	0·62	20·60	100
Pulses				
Peas (dried)	1·85	0·17	4·75	28
Dals	6·50	0·99	16·20	100
Grams	5·70	1·30	15·30	96
Milk and Milk Products and other Foods				
Cow's milk	0·94	1·02	1·36	18
Butter milk	0·85	0·14	1·36	10
Dadhi	1·50	2·00	1·41	30
Sandesh	5·40	—	12·00	124
Oil and Ghee	—	27·7	—	211
Potato	0·45	0·3	5·1	25·5
Onion	—	—	—	12
Other vegetables	·55	1·4	3·4	29
Lehi or Muri	1·65	0·75	23·4	103·5
Fish	4·75	1·2	—	30·5
Meat	3·75	4·1	—	53
Sugar	—	6·00	27·7	114

The average percentage composition of the chief cereals and other foods of Northern India is given below:

Cereals	*Protein*	*Fat*	*Carbo-hydrate*	*Ash or Mineral*	*Crude Fibre*
Wheat	8·4	1·8	73·7	1·7	1·5
Barley	7·5	1·8	71·9	2·3	3·9
Jowar	7·4	3·2	73·1	2·2	1·4
Rice	7·4	0·4	79·2	0·4	0·2
Maize	9·4	4·7	72·5	1·4	1·4
Chhana	18·6	4·8	56·3	2·8	6·2
Pulses and other Foods					
Arhar	14·3	1·5	63·7	3·5	6·2
Mung	18·7	1·0	62·2	3·7	3·4
Urd	22·3	1·0	57·5	4·1	3·4
Masur	23·0	1·1	61·1	4·4	2·4
Potato	1·8	0·1	14·5	0·8	20·5
Onion	1·4	0·3	10·8	0·5	10·5
Cow's milk	3·5	5·8	4·5	—	—
Buffalo's milk	4·3	8·7	4·9	—	—

Basu and Basak have recently calculated the biological values of proteins of certain crops in India by the balance-sheet method:

Crops	*Biological Value of Proteins*	*Protein Values*
Aus rice (Dharial)	80	4·73
Aman rice (Bhasamanik)	80	5·53
Field pea	41	11·7
Lathyrus sativus	44	14·4

Physiologists now aver that the quality of proteins in rice, potato or pea is much superior to that in wheat, maize and other cereals. Wheat is a valuable source of carbohydrate and Vitamin B. The following table has been derived from the U.S.A.:

Proteins from	*Relative Nutritive Value*
Fish, meat, milk, egg	100
Rice	88
Potato	79
Pea, pulse	56
Wheat	40
Maize	30

The nutritive value of a cereal is accordingly different from its mere protein value; and it is the former which is really more significant for the purpose of keeping the body functioning well. In Japan attention has been drawn to the fact that 25 qualities of rice of different origin (northern provinces, Siam, etc.) show striking variations in their chemical composition. Investigations relating to the nutritive value of different kinds of rice, wheat, millets, milk and dairy produce in different parts of India will also reveal similar differences.

CHAPTER V.

NUTRITION LEVELS IN DIFFERENT REGIONS AND CLASSES

VARIETY OF FOODS IN INDIA.

The following table indicates the variety of the chief cereals and pulses consumed in different parts of India by the masses of workers and peasants.

Province	*Cereals*	*Percentage Estimate of Consumption*	*Pulses*
Punjab	Wheat	(90)	Gram, mash, masur
	Maize	(5)	
	Rice	(5)	
United Provinces	Wheat	(60)	Arhar, gram, urd
	Rice	(30)	
	Bajra	(5)	
	Jowar	(5)	
Bihar	Rice	(80)	Arhar, masur, urd and khesar
	Wheat	(10)	
	Maize	(10)	
Bengal	Rice		Kalai, mug and arhar
Central Provinces	Rice	(47)	Arhar, gram, lakhori, masu and urd
	Wheat	(36)	
	Jowar	(17)	
Bombay	Rice	(40)	Gram, tur and mug
	Wheat	(50)	
	Jowar	(2)	
	Bajri	(8)	
Madras	Rice	(30)	Arhar and gram
	Ragi	(70)	

The relative percentages of the consumption of cereals in the different Provinces are roughly estimated on the basis of family budgets of working classes collected by Provincial Governments and non-official agencies. Roughly speaking there are about 240 million rice-eaters and 100 million wheat-eaters in India.

The following table arranges foodstuffs according to the order of relative richness in nutrients:

Proteins	*Fats*	*Carbohydrates*	*Calories*
Arhar	Gram	Bajra	Bajra
Gram	Arhar	Rice	Wheat
Wheat	Jowar	Maize	Barley
Barley	Barley	Barley	Arhar
Bajra	Wheat	Wheat	Rice
Rice	Maize	Jowar	Gram
Jowar	Bajra	Arhar	Maize
Maize	Rice	Gram	Jowar

The amount of different food elements and calories available per rupee obtained from the important food-stuffs used in the United Provinces are given in the following table, which can be of help in selecting the food-stuffs on an economic basis.

TABLE SHOWING THE AMOUNT OF DIFFERENT FOOD ELEMENTS AVAILABLE PER RUPEE

Food	*Amount per Rupee*[1]		*Proteins*	*Fats*	*Carbohydrates*	*Calories*
	Seer	*Chataks*	*Amount in Chataks*			
Wheat	7	$8\frac{5}{11}$	16 10	2 22	84 03	24,566
Rice	5	$6\frac{1}{2}$	6 82	0 25	66 16	17,130
Bajra	10	$6\frac{4}{11}$	15 86	2 62	133 26	36,279
Barley	10	$13\frac{1}{4}$	17 64	3 68	122 39	34,650
Jowar	10	12	12 79	4 13	112 89	32,524
Maize	10	8	12 25	2 76	119 83	32,256
Gram	8	3_{16}	25 61	5 84	68 79	25,171
Pulses (Arhar)	6	—	21 57	3 25	55 32	19,200

[1] Based on the average of fortnightly retail prices current in Cawnpore during 1928.

Observations and experiments in China, Japan, India, the Philippines and Java have accumulated, as we have seen, to show that people living in tropical climates eat less, especially less protein, exercise less and that they have a lower metabolism. Now during the greater part of the year, the climate in India is of the hot humid type and is predominantly relaxing, especially in Bengal and Southern India. Such conditions are associated naturally with a lower metabolism.[1] The muscular tone of the Indians is as a rule constantly lower than that of the Westerners and this is the chief reason for the lower basal metabolic rates of the former. Climatic conditions and a dietary low in protein and fat indirectly affect metabolism. McCay's investigations in Bengal and Wong's investigations in China relating to protein ingestion and nitrogen excretion show that the relaxing effect of the climate predominates over the relatively stimulating effect of the diet.[2] In the humid climate of Bengal and Madras, people with a metabolism averaging 11 to 13 per cent below the western standards thrive well by eating less, especially less protein and exercising less than in Northern India.

THEORETICAL FOOD STANDARDS IN INDIA

In a standard diet for an Indian worker the following distribution of food materials is desirable.

1. The minimum protein intake in India should be 75 to 85 grammes a day, of which about 25 grammes should preferably be animal protein. McCarrison's standard is 100 grammes, while that of Sherman is about 44 grammes and Hindhede's 60–70 grammes.[3] It must be remembered that vegetable proteins

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[1] Necheles: *American Journal of Physiology*, XCI, pp. 661–663.

[2] Earle: "Basal Metabolism of Chinese and Westerners," *Chinese Journal of Physiology*, Report Series, 1928, No. 1.

[3] In Japan the protein standard adopted by the Director of the Nutrition Institute, Tokyo, is 80 grammes, and the caloric standard is 2,400 C. For China 78·6 grammes of protein, 78·6 grammes of fat and 2,360 calories represent the standard according to the Institute of Medical Research, Shanghai. In Java the standard adopted is 60 grammes of protein, 49·5

are not easily assimilable. The co-efficient of digestibility of animal proteins is 97 per cent, while that of cereals is 85 per cent and that of dried legumes only 78 per cent when used in a mixed diet. When cereals and legumes form the bulk of the diet, as in India, the co-efficient is apt to be even lower.[1]

2. Fat should provide 20 per cent of the total calories in Europe, but in a warm country like India much less is needed. McCarrison's standard is 80 grammes, of which half should be animal fat. More proteins and fats are no doubt necessary in Northern India than in Bengal and Madras, where a fair grade of efficiency may be ensured with 75 grammes of protein and 50 grammes of fat. The Inter-Allied Food Commission adopted only 75 grammes daily as the minimum fat ration during the war.

3. The balance of energy value other than protein and fat should be provided by carbohydrates representing about 500 grammes, the whole yielding 2,400 calories. Carbohydrates and fats, being both sources of energy, can replace each other in large measure. Comparing Punjabi with Bengalee or

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grammes of fat, 428 grammes of carbohydrates and 2,402 of total calories. (*Report of the Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene*, Geneva.) Since the above was written Aykroyd has also fixed the standard of total protein requirement per adult in India as 50 to 65 grammes, of which animal protein is only 16 grammes. Successful low protein experiments conducted by Hindhede and Marsden show that in the accepted western standard, the minimum requirement of protein is pitched too high. Plumer observes: "The diet drawn up by Hindhede from his own work and experience is similar to those eaten by certain native races in the Himalayas and in certain parts of China and the East. These peoples have the finest health and physique and do not suffer from the intestinal diseases of the European or from cancer. There seems no question but that Hindhede is right. Most people as well as the medical profession are imbued with the doctrine of high animal protein, and scarcely dare to make any alteration" (*Nature*, June 22, 1935). The nutritional responsibilities assigned to the protein now seem to belong rather to the mineral elements and vitamins.

[1] Leitch: *Dietetics in Warm Climates*, p. 167.

Madrasi diets, for instance, we find that in the former a larger quota of fats derived from animal products generally accompanies a lower carbohydrate consumption than in the latter cases.

On the basis of the investigation of the basal metabolism at Lucknow, Calcutta and Bombay, which showed that from 1,200 to 1,400 calories represented the resting need as compared with 1,600 to 1,800 calories in the U.S.A., McCarrison's standard of 3,500 calories appears to be too high. Estimating an addition of 1,000 to 1,200 calories to the figure for minimal metabolism when work in the fields is involved, and of 10 per cent for recoupment of waste in a dominantly vegetarian dietary we may fix up our theoretical standard at 2,500 to 3,500 calories for India, and distribute the proximate principles as follows for Northern India, and Bengal and Southern India respectively.

	Calories	*Proteins*	*Percentage to the total number of calories*	*Fats*	*Percentage*	*Carbohydrates*	*Percentage*
		Grams		*Grams*		*Grams*	
Northern India (Wheat and legume eaters)	3,000	85	11·6	60	18·6	605	82·68
Bengal and Southern India (Rice and legume eaters)	2,400	75	12·81	50	19·37	472	80·63
McCarrison's Standard	3,500	100	11·71	90	25·45	450	52·71

We give below a set of standards of requirements compiled by Stiebeling, of the Government Bureau of Home Economics, U.S.A. Stiebeling's table includes mineral elements and vitamins, and has recently been accepted as the basis of analysis of British diets by the Rowett Institute under Orr.

Protein	*Calcium*	*Phosphorus*	*Iron*	*Vitamin A (Sherman)*	*Vitamin C Units*	*Energy Value Calories*
67	0·68	1·32	0·015	4,000	100	3,000

Fat requirements are not given by Stiebeling; Orr adopts 98 grams on the basis of standards suggested by Holt and Fales.

Milk and milk products are important sources of calcium in the Indian dietary, though we are unable to know accurately how much of it is lost with the protein, which, separated during long cooking, is strained off. Where there is deprivation of these the calcium supply tends to run short. Especially is this the case with the village mothers. Raw cane sugar, used in the villages, also supplies calcium. Cabbage, lal shak, gima shak and pooin shak (*Bassela cordifolia*) are rich in calcium. Phosphorus is generously supplied by the food grains and by *patol* (*Trichosanthes dioica*), pooin shak and *bhindi* (*Hibiscus esculentus*), while the iron chiefly comes from the green foods freely used by the villagers, especially in the wet season, and from raw sugar. Lal shak, gima shak, kolmi shak (*Ipomœa reptans*) and palong shak (*Spinach olerace*) are particularly sources of iron.

Ghosh, Guha and co-workers have reported results of a series of investigations of the vitamins in important Indian food-stuffs and their results are summarised here. The whole bodies of fishes have varying degrees of Vitamin A potency, *rohit* (*Labeo rohita*), *parse* (*Mugil parsia*) and *tangra* (*Aoria tengora*) being among the richest and *hilsa* (*Clupae ilisa*) being the poorest among 12 varieties of fish that have been investigated. Among the pulses kanchamung (*Phaseolus mungo*), chola (*Cicer arietinum*), masur (*Lens esculenta*) and mator (*Pisum arvense*) are fairly good sources of Vitamin A, comparing well with some of the fishes. Green vegetables are, of course, fairly good sources of Vitamin A, owing to their carotene content. Among the fruits, the mango is a very rich source of Vitamin A. Whole cereals are usually good sources of Vitamin B_1, but highly milled rice, as is usually taken, is deficient in this vitamin. Among the pulses, kanchamung is a rich source of Vitamin B_2. Vegetables as a rule, are rather low in this vitamin. Begun (*Solanum melongena*) and shakalu (*Pachyrhizus angultus*) are good sources of Vitamin B_2. Among the pulses studied, mator (*Pisum arvense*) is the richest source of Vitamin B_2. Among the green vegetables, the richest sources of Vitamin B_1 are pooin shak, bhindi, gima shak and cabbage. Patol, palong shak and man-kochoo (*Colocasia Indica*) are fairly good sources of Vitamin B_2. Mango is a fairly good source of both Vitamins B_1 and B_2. An investigation of about 40 Indian food-stuffs by the same authors has revealed that the guava, mango, shaddock (*Batapi lebu*), lichi and pine-apple are richer in Vitamin C than the orange and lemon, the well-known anti-scorbutics. Country liquor from the date is a rich source of Vitamin C, being about 10 times as potent as an ordinary sample of human milk obtained from Bengali women. It is interesting to note also that the conversion of cow's milk into curd, instead of causing any loss of Vitamin C, serves actually to stabilise it (unpublished results).

VITAMINS IN INDIAN FOOD-STUFFS

(as recorded by Ghosh and Guha)

TABLE I

As no international standard of Vitamin A was available at the moment for comparison, one unit of Vitamin A was defined to be the amount of foodstuff which would produce a weekly gain in weight of approximately 10 g. for a period of three to four weeks under the above conditions.

Serial No.	FOODSTUFFS Vernacular Names	Botanical Names	Units of Vitamin A (in 100 g)	Units of Vitamin B (in 100 g)	Units of Vitamin C (in 100 g)
	FISH				
1.	Bhetki-fish	*Lates calcarifer*	33	16	4
2.	Kholsa-fish	*Trichogaster fasciatus*	33	33	25
3.	Koi-fish	*Anabas testudineus*	20	10	2
4	Magur-fish	*Clarias batractus*	10	8	33
5	Mrigel-fish	*Cirrhina mrigala*	33	10	0
6.	Parse-fish	*Mugil parsia*	60	10	16
7.	Rohit-fish	*Labeo rohita*	83	18	50
8.	Tangra-fish	*Aoria tengara*	77	0	2
	PULSES				
9.	Chola-dal	*Cicer arietinum* (Leguminosæ)	66	15	66
10.	Kancha-mung (germ)	*Phaseolus mungo* (Leguminosæ)	30	10	16
11.	,, (ungerm)		100	100	36
12.	Masuri-dal	*Lens esculenta* (Leguminosæ)	45	40	25
13	Mator (Patnai)	*Pisum arvense* (Leguminosæ)	45	40	80
	VEGETABLES				
14.	Alu (Nainital)	*Solanum tuberosum* (Leguminosæ)	—	40	35
15	Am (Fozli)	*Manifera indica* (Anacardiceæ)	30	33	30
16.	Begun (Egg fruit)	*Solanium melongena* (Solanaceæ)	—	20	100
17.	Hinche	*Enhydra fluctuans* (Compositæ)	—	28	10
18	Kanthal (Jack-fruit)	*Artocarpus integrifolia* (Artocarpaceæ)	—	20	16
19.	Karella	*Momordica charantia* (Cucurbitaceæ)	—	20	20
20.	Shak-alu	*Pachyrhizus angultus* (Leguminosæ)	—	35	100

VITAMIN C CONTENTS IN INDIAN FRUITS

TABLE II

Serial No	*Vernacular Names*	*English Names*	*Botanical Names*	*Ascorbic acid (mg) as calculated from Dye Values per g of Fresh Foodstuff*
1.	Peara	Guava	*Psidium gujava*	1·04 mg.
2.	Am (Langra)	Mango	*Mangifera Indica*	0·69

VITAMIN C CONTENTS IN INDIAN FRUITS—*contd.*

TABLE II

Serial No.	*Vernacular Names*	*English Names*	*Botanical Names*	*Ascorbic acid (mg.) as calculated from Dye Values per g. of Fresh Food-stuff*
3.	Lichoo	Lichi	*Nephelium lichi*	0·48
4.	Kancha lanke (Maldah)	Chilli	*Capsicum Indicum*	0·45
5.	Am (Fozli)	Mango	*Mangifera Indica*	0·34
6.	Uchche	,,	*Momordica Charantia*	0·33
7.	Kamranga	Carambola	*Averrhoe Carambola*	0·23
8.	Anarash (Indian variety)	Pine-apple	*Ananas Sativa*	0·22
9	Lebu	Lemon	*Citrus medica*	0·19
10	Papaya	Papaw	*Carica papaya*	0·19
11.	Bel (Paka)	Wood-apple	*Aegle Marmelos*	0·18
12.	Kamala-lebu	Orange	*Citrus Aurantium*	0·18

MINERAL AND PROTEIN VALUES OF SOME COMMON INDIAN VEGETABLES AND FRUITS

TABLE III

	Percentage in the edible portions of fresh vegetables			
	Iron	*Calcium*	*Phosphorus*	*Protein*
String bean	0·0011	0 060	0·199	3·64
Green pea	0·0026	0·036	0·224	6 42
Cauli-flower	0·0011	0·054	0·150	2·42
Bitter gourd	0·0034	0·037	1·336	1·11
Radish	0·0018	0·055	0·059	0·69
Egg fruit	0·0006	0·020	0·776	1·27
Papaw	0·0013	0·135	1·290	1·02
Bengali bean (shim)	0·0017	0·085	0·162	2·67
Plantain flower	0·0013	0·032	1·605	1·93
Potato	0·0011	0·016	0·148	0·89
Sweet potato	0·0055	0·012	0·168	1·03
Sweet gourd	0·0012	0·059	0·096	0·95

It is significant that immemorial custom in the Indian village permits children from the poorer homes, to pick the tender shoots of legumes and mustard plants which they carry home, to eat there fresh, suck the stalks of the immature canes of the fields or gather cucumber, mango, guava, lemon and other fruits supplying some vitamins, minerals and calories they need. The children's foraging is not resented.

ANALYSIS OF ACTUAL PEASANT AND WORKING-CLASS DIETS

A close investigation of the peasant and working-class dietary in different parts of India shows that the diet is usually adequate in its calorific value, but is not well-balanced and apt to be too bulky. The bulk of calories is derived from cereals and pulses. On an average 10 per cent of the total calories needed are obtained from protein in India among the industrial workers, as compared with 18 to 19 per cent in Swedish and French diets, and about 7.5 per cent on an average from carbo-hydrates as compared with 50 per cent of the energy content in Western diets.

DISTRIBUTION OF QUANTITIES OF FOOD MATERIALS AND CALORIES IN PEASANT AND WORKING-CLASS DIETS IN INDIA

	Proteins (in grams)	*Percentage to Total Number of Calories*	*Fats (in grams)*	*Percentage to Total Number of Calories*	*Carbo-hydrates (in grams)*	*Percentage to Total Number of Calories*	*Total Calories*
Proposed Indian Standard Requirement	85	11 6	60	18·6	605	82·68	3,000
Indian Army—Peace Scale (Wheat-eaters)	93 7	11	56 2	15	625·8	73 9	3,470
Indian Army—Peace Scale (Rice-eaters)	58·5	7·1	50·1	13·7	654·3	79·2	3,386
Punjab cultivator (McCarrison)	120	3·3	70	18·9	560	78·0	3,440
Punjab cultivator (Barry)	104	15·8	14·13	5·1	541·3	81·9	2,708
Punjab jail diet	113·4	16·1	26·8	8·6	612·8	87·2	2,880
Punjab cultivator (Kartar Singh)	110·2	11·2	54·9	12·7	769·8	76·1	4,014
U.P. farm hand	99·9	17·7	23·9	9·6	487·3	76·4	2,310
U.P. mill worker	90	13·2	45	14·9	530	77·6	2,800
A colliery hookman, Bauri	76·4	10·3	7·3	2·1	725·5	90	3,025
A miner in Bihar coal-fields (Seth)	64·1	9 8	20·3		505·5	78	2,599
Bombay woman mill-worker (S.K. Talpade)	57	10·4	38·0	15·7	413	75·7	2,234

DISTRIBUTION OF QUANTITIES OF FOOD MATERIALS AND CALORIES IN PEASANT AND WORKING-CLASS DIETS IN INDIA—*contd.*

Bengali jute mill worker (A.C. Roy Chowdhury)	66	10	41	14	526	76	2,752
Bengal jail diet	93·31	10·9	30·49	8·1	693·33	81	3,508
Hindustani cotton-mill worker in Bengal (A.C. Roy Chowdhury)	68	12	45	18	401	70	2,340
Madras farm hand (McCarrison)	58·32	10·7	2·75	1·1	536·8	99	2,222
Madras Coolie (McCarrison)	68·7	8·1	7·2	2·1	789·2	89·9	3,226
Chinese factory hand (Ting-an-Li)	92·1	13	35·2	11·2	551	77·8	2,899
Japanese worker (Inata)	95	13	16	5·0	600	82·0	3,000
American (Pearl)	95	13·3	113	36·2	447	63·1	3,185
Royal Society Food (War) Committee	100	12	100	2·7	500	60·4	3,390

In Indian food investigations the proportions of mineral elements and vitamins have not been worked out. A recent food research by Charlotte Viall Wiser indicates, however, the following mineral deficiency in diets of a family of Brahmin farmers in Mainpuri, United Provinces[1]:—

	Calories	*Proteins (in grams)*	*Calcium (in grams)*	*Phosphorus (in grams)*	*Iron (in grams)*
Total amounts needed daily	16,609	422·7	4·600	6·972	·104
Total amounts consumed daily in May	13,855	466·8	3·699	13·216	·144
Total amounts consumed daily in November	16,865	440·66	2·227	11·539	·120

Calcium is the most consistent deficiency, which is offset in some measure by the consumption of milk and *ghee* in the summer months when agricultural work is heavier. The milk of the Indian cows and buffaloes is also considered to be deficient in calcium. Pal and Guha's recent analysis of the

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[1] Wiser: *Foods of a Hindu Village of North India*, p. 95.

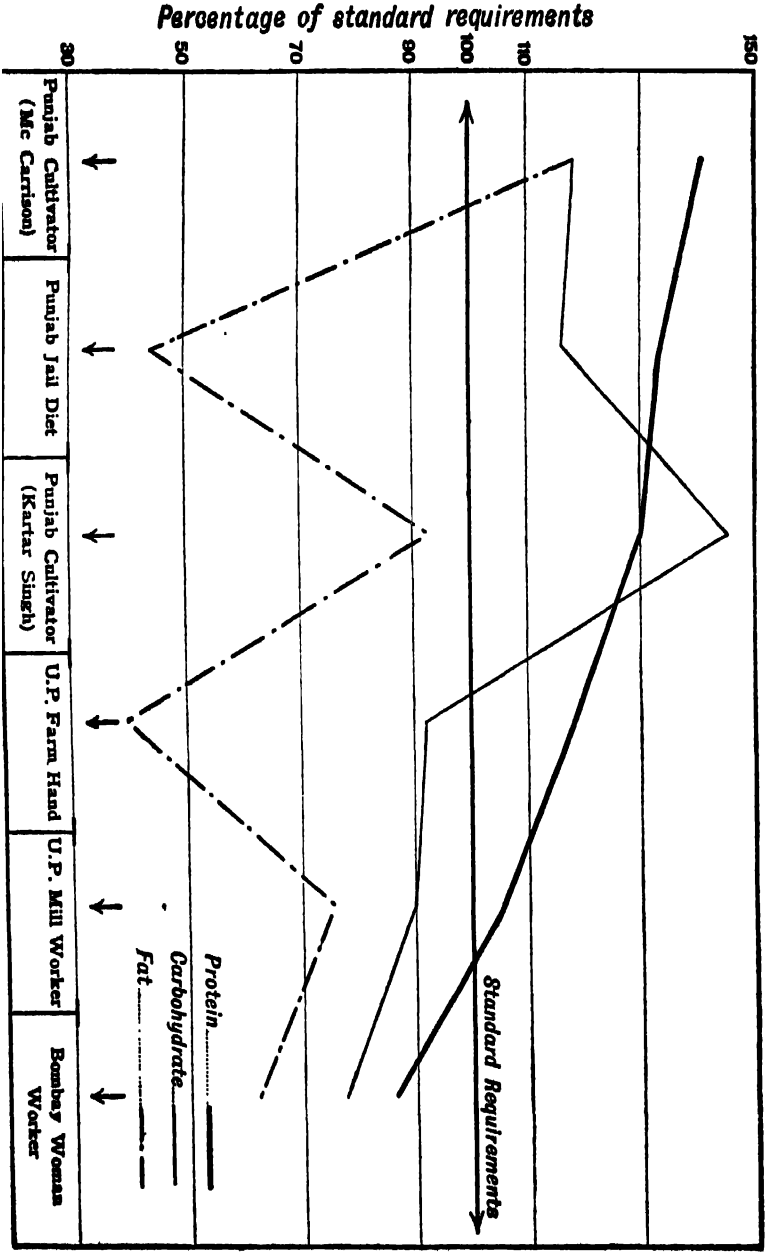

FIG. 5.—FOOD INTAKE AND FOOD REQUIREMENTS: THE PUNJAB, THE UNITED PROVINCES AND BOMBAY

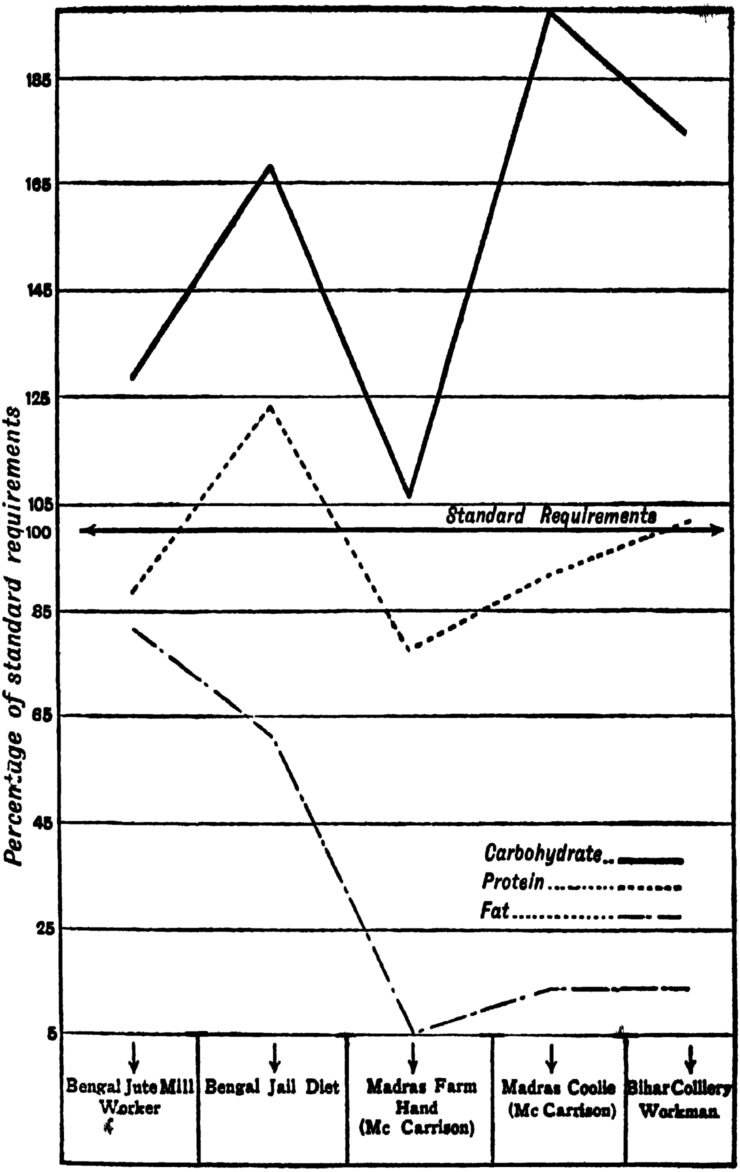

FIG. 6.—FOOD INTAKE AND FOOD REQUIREMENTS: BENGAL, BIHAR AND MADRAS

nutritional values of cooked diets from some students' hostels and middle-class families in Calcutta has also yielded some interesting results. The averages for protein and calcium work out to be lower than Stiebeling's standard values but higher in the case of iron. Deficiency is, therefore, indicated mainly in respect of calcium and protein, especially of protein of animal origin.

DIET AND INDUSTRIAL INEFFICIENCY

Industrial workers in India are accustomed to a more varied and more adequate dietary in the cities than the peasants in the villages. It will appear from an analysis of several working-class dietaries that the industrial worker in India generally obtains, as he requires, more calories than are needed by the Indian peasant or a professional man engaged in sedentary pursuit. Thus the calories per adult worker of the most numerous grade in Cawnpur with an income of Rs. 15 to Rs. 30 per mensem (2,800 calories) are higher than the estimate of calories needed for a professional worker or a peasant calculated on the basis of a study of the basal metabolism of the latter. On the other hand the calories which the Indian working man's diet yields do not reach the level at which the British working man's dietetic position ordinarily stands. The following comparison is significant.

	Basal Metabolism Calories	*Diet*
British working man	**1,700**	**3,500**
Indian working man	**1,200**	**2,800**

The former has a surplus of 1,800 calories to expend on bodily movement (including his work) while the latter has 1,600 calories only. It is usual to deduct-

10 per cent from the theoretical caloric value of a mixed diet to allow for the loss due to non-assimilation, which is more marked on a vegetable than on an animal diet. Thus the caloric value of the Indian working man's diet comes to 2,520 calories. The surplus available to the Indian labourer in excess of resting requirements is accordingly reduced to 1,320 calories, as compared with the British labourer's 1,800 calories. A part of this difference is accounted for by lower weight, but the difference indicates not merely less stamina and more apathy, but also less strenuous work, which may be forthcoming. For moderate work 700–1,100 calories, and for heavy work 1,100—2,000 calories in excess of resting requirements has been estimated by the Food Committee of the Royal Society to be indispensable on account of the increase of metabolism.

It has also been found that the expenditure of calories increases thrice when the rate of working is doubled. Both climate and physiological adjustment have fitted the Indian factory hand to work at a slower pace, and if he has to labour unremittingly and strenuously for long hours he adjusts himself by occasional idleness as well as absenteeism. There is no doubt that work under factory conditions both in India and in England demands strenuous expenditure of energy and its recoupment. It is true that the warmth of the climate does not require heat production to offset heat loss as in the Western countries, but, on the whole, the pressure of unremitting work is standardised; production in the factories can only be maintained for long, and successfully, on a diet which is physiologically more nutritive. This pressure is responsible to a no small extent not merely for industrial inefficiency but also for greater absenteeism and prevalence of disease and mortality among the factory workers in our country. Finally, it is found that the Indian worker has probably a greater degree of relaxation during rest than has the Western worker. This has been attributed to the latter's nervous tension on account of which he finds complete repose *only* during sleep.[1] If this be so, the distribution of rest pauses between intervals of work in factories will increase industrial efficiency and output in larger measure than is expected in the West. The basal metabolism which we measure at the physiological laboratory might thus be of great aid to the economist and the factory manager in determining the hours of labour and intervals of rest for the maximum industrial output. Similarly, the results of investigations of the specific effects of nitrogenous foods on hard work may contribute materially to the increase of industrial efficiency. The co-operation of physiology, psychology and economics is essential in order that we may analyse and control all the factors which govern both the speed and volume of production in a country. It is, indeed, imperative that man's labour and repose should be regulated by the methods of science so as to ensure at once the maximum output and' well-being; and recent advances in our knowledge of vital activity and nutrition clearly indicate that such regulation would differ according to climate, region and race.

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[1] Mason and Benedict: *Indian Journal of Medical Research, July,* 1931.

CHAPTER VI

AGRICULTURAL ADAPTATION TO POPULATION PRESSURE

CLIMATE, CROP AND DIETARY

We may now assess the dietary standards we have fixed in terms of the regional cereals and food materials and relate the results of physiological investigations of average diets with the economical use of the land and efficiency of the people in different parts of India. Only certain general relations may be indicated.

Throughout India the food materials are determined by what the fields yield under different conditions of climate, soil and water-supply as well as density of population.

The physical characteristics of the Indian peoples, their dietary, food-grains and agricultural practices, are all governed by regional conditions. In the Punjab and in Bengal or Madras the energy required in the maintenance of body heat and work varies, and so also vary both the kinds of food and level of nitrogenous equilibrium as well as the weight and stamina of peoples. In Northern India the climate as well as the diet are stimulating; while in the humid climate of Bengal and Southern India the metabolism is lower, and there is less demand for heat production and less protein ingestion. The large variety of the Indian dietaries is due to the regional differences of cropping and agricultural practice, and of physiological needs of work and recoupment in different climates and under varying conditions of population pressure.

Cereals afford an economical source of proteins, but these differ in their nutritive quality a great deal. In the different parts of India, wheat and certain millets like *ragi* or *cambu* of the South are of higher nutritive quality, while grains of less nutritive quality are maize and rice. No doubt the difference in the nutritive quality of cereal grains cultivated in the different agricultural regions of India play a large part in governing the physical efficiency of different races and peoples. With economic progress and rising standards of living there is a tendency in India towards an increasing *per capita* use of more esteemed cereals such as wheat, rice and maize, and a decreasing use of the less esteemed cereals like barley, millets and gram, and perhaps absolute increase in cereal consumption. On the other hand, in a country like the United States further economic advance has led to decline in the use of cereals. In the United States the higher the income the lower the place of cereals, which are usually the cheapest foods in diet.

POPULATION PRESSURE AND CHANGES IN CROPPING

As a result of excessive population pressure important changes in agriculture and food are taking place in India. With an increase of population density, barley is replacing not only jowar and other light-yielding crops but also wheat in the eastern districts of the United Provinces. The output of barley per acre is slightly greater but on the whole its food-value is much less than that of wheat.

The following table would compare the relative increases of production of the major cereals, the yields per acre and calories and proteins available per rupee-worth of the cereals.

Cereal	*Percentage Variation of Volume of Production in India since the Quinquennium* 1910–1915	*Average Yield in lbs. per Acre*		*Calories (Available per Rupee-worth of Cereal)*	*Proteins (Chataks)*
		U.P.	*India*		
Wheat	1	1,000	811	24,566	16·1
Rice	10	900	988	17,130	6·82
Barley	74	1,150	1,029	34,650	17·64
Jowar	110	600	626	32,524	12·79
Bajra	30	550	452	36,279	15·86
Maize	5	1,050	933	32,256	12·25
Gram	9	750	685	25,171	25·61
Arhar	—	750	815	19,200	21·57

During the last three decades, wheat has shown a distinct slackening of production and the total output actually diminished in 1932–1933 as compared with 1910–1915. Rice has increased by only 10 per cent, and there has been a contraction in both area and production since 1931–32. But it is the inferior cereals—barley, jowar and maize—which have shown remarkable increases, particularly jowar, which has more than doubled in production. Barley, bajra and jowar are the poor man's crops and foods in India, wheat and rice requiring better land, more capital resources and more manuring and irrigation. Some barley goes to England from India for malting, but in the main it is of inferior quality. Barley, though poorer than wheat, is richer than rice and millets as regards the proportions of protein and fat. In view of the deficiency of the peasant dietary in protein, the production of barley for the export market is not desirable. Physiologists and agricultural experts should co-operate in India in order that the peasant may be usefully advised, so as to obtain the highest yield of proteins per acre from the different kinds of food grains and the largest utilisation of human and animal power in the existing level of cereal prices. The mixture of wheat with barley, gram, pea or mustard, characteristic of agricultural practice in large parts of India, also indicates the cultivator's resort to inferior cropping due to economic pressure and adjustment to drought conditions, pure wheat giving a heavier yield under irrigation. In some parts of Oudh wheat production is not expanding at all, while the cheap food grains, *kodun* and *mandua*, have largely increased in output.

In Japan, on the other hand, with an improvement in the standard of living of the peasants, barley and naked barley and also millets have decreased in acreage; and rice has to a large extent taken the place of dry grains in the national diet, and is more effectively used by all classes of people. Japanese economists are happy in the knowledge that a larger proportion of the population is now using rice as its staple food instead of a mixed diet of rice and of some other cereal.[1] "Consumers of rice," observes Penrose, "enjoy here greater social prestige than consumers of barley." The trend of the production of animal foodstuffs has also shown a much more rapid increase than that of vegetable foodstuffs in Japan, although the present absolute consumption is extremely small.[2]

Both the dominant place of cereals in the Indian diet and the increased consumption of barley and cheaper millets at the expense of wheat or rice indicate the weakness of the Indian food position.

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[1] Allen: *Modern Japan and Its Problems*, p. 186.

[2] Penrose: *Population Theories*, p. 131; Hall, "Agricultural Regions of Asia," *Economic Geography*, April, 1933.

The poorer sections of the population in Northern India use bread of mixed inferior grains with *sak* or turnip, the grains used being barley, maize, *china*, *bajra*, *jowar*, *moth*, *mandua*, *or kodo*, according to the locality. In considerable parts of India droughts are recurrent. Every year of agricultural scarcity or adversity is associated with a large and even wholesale substitution of wheat by barley and the cheaper millets, and a complete omission of animal products, fruits and vegetables. In Japan, as we have already indicated, the millets formerly made up a more important part of the peasant's dietary than they do to-day. Like the greater use of sorghums and millets in China, the increase of consumption of the cheaper millets in India indicates a lower purchasing power of the people. This is aggravated when successive droughts lead to a great shrinkage in the wheat and rice crops.

CROP ADJUSTMENT TO HIGH DENSITY

India's changes in cropping are largely governed by the necessities of irrigation and the precarious rainfall, and the facilities of transport and credit. A right combination of cash crops, like cane, cotton and jute, and heavy-yielding food crops has evolved only in a few areas under the stress of economic pressure, furnishing the stable economic basis of an exceedingly high rural density. In Eastern Bengal, for instance, aman, jute, *china* or *kaon* (both being varieties of millet) and gram and oil-seeds grown as catch crops, maintain an exceedingly dense population, even as the combination of paddy and tapioca and money crops, such as coconut and pepper, does in Travancore. In this State the mean density per square mile of the total area is 668 and 1,486 of the net cultivated area. The response to population increase is an expansion of the area under pepper and coconut more than under paddy and tapioca, the chief food crops, and import of rice from Burma.

	Percentage Increase of Area 1921–1931	*Percentage Increase of Output* 1921–1931
Paddy	2·5	11·0
Tapioca	18·9	18·8
Coconut	23·5	23·9

In the case of pepper, rubber and tea the export trade increased by 11, 245 and 51 per cent respectively.

The recent fall of jute prices, however, has given greater shock to the farming organisation in Bengal than elsewhere, and the *aus* rice and *rabi* crops, which jute had replaced, are being grown again more and more in Eastern Bengal. It appears that the crop rotation in Eastern Bengal in the middle of the nineteenth century was on the whole better adjusted to soil and population conditions and that this rotation was upset by the introduction of the money-crop, jute. Colonel Gastrel gave some details relating to the agriculture of Faridpur, which he based on the Revenue Survey of 1860. From his Report it appears that much greater areas were sown with *rabi* crops and oil-seeds in Eastern Bengal than at present, while sugar-cane covered a great deal of land and was a profitable crop. Jute, which is an exhausting crop, was little grown, covering only 10,000 acres in Faridpur as compared with 240,000 in 1914 and 140,000 acres in 1934; but indigo, a valuable legume, was then the principal crop; while the famous Bengal cotton had also been in all probability of considerable importance. Indigo and cotton have now altogether disappeared. With the diminution of jute cultivation the *rabi* crops, including the protein-bearing beans and pulses and oil-seeds, will come to their own in the eastern districts and secure better dietary for the cultivators.

Unfortunately in Western Bengal, where a new agricultural adjustment to drought conditions call for the stress of *rabi* cropping by means of irrigation, the disrepair and disuse of tanks and bundhs have led to a phenomenal decline of the area under *rabi*. In the last ten years, 1924–1934, the decline is shown below:—

Murshidabad	182,200 acres	Nadia	14,100 acres
Burdwan	21,100 acres	Jessore	15,600 acres

Aus, however, has been expanding in Central and Western Bengal, except in Birbhum, Burdwan and Jessore where it has seriously declined. Oil-seeds have greatly declined in many districts in Bengal and are at present of small importance in the agriculture of Bengal, where, however, the mustard oil is of such great importance in the dietary and in the toilet under excessively damp conditions. In 1924 Bengal grew oil-seeds in 10 lakhs of acres; the acreage was the same in 1934. The decline between 1924–1934 is shown below:—

Murshidabad	19,400 acres	Nadia	3,700 acres
Burdwan	4,500 acres	Jessore	5,500 acres

Not only oil-seeds such as mustard and castor but also sann hemp and *mash kalai*, both soil recuperative crops, may come in easily in crop planning in the place of jute, where the area has to be restricted or [illegible] although their deficiency [illegible] drawback. It has been suggested [illegible] should be exposed to the sun for a [illegible] years [illegible] use; they would then develop Vitamin D; also that they should be deodorised and treated with Vitamins A and D in the process of manufacture.

Similar risks of unsettlement of farming economy are associated with the expansion of cane, due to the recent development of the indigenous sugar industry with the aid of the protective tariff. Cane, which remains in the land for at least nine months and generally about a year, requires long fallowing and tends to supersede the legumes and fodder crops besides lowering soil fertility and the yield level of the subsequent cereals.

THE IMPORTANCE OF THE LEGUMES

The leguminous crops replenish soil fertility and are valuable sources of protein. In the congested eastern districts of the United Provinces the development of double cropping, as a result of heavier population pressure, had led to a remarkable expansion of gram and peas. In Jaunpur alone between 1841 and 1908 the pea area expanded from 75,000 acres to 81,373 acres.[2] Peas ripen early and the

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[1] J. M. Ghosh: *Bengal Board of Economic Enquiry Bulletin: Pabna.* As regards the relative value of the legumes as recuperating crops the yields of succeeding crop or crops appear to be best maintained after ground-nut, *mung*, soya bean, *matar*, pea and *laxhori* in different parts of India. Fertility is not merely maintained but is also actually increased by the judicious inclusion of leguminous crops used as green manure or fodder. The use of green manuring of sann hemp, *dhaincha*, *pillipesara*, horse gram and cow pea in particular has given effective yields on subsequent crops.

[2] *Over-population in Jaunpur*, by Misra, the present writer's Introduction, p. 2.

[illegible] pop[illegible] which is [illegible] without pastures and grazing grounds. Lately, however, the expansion of cane has led to a great shrinkage of pea and *arhar*, especially in Gorakhpur.[1]

A judicious crop planning also depends upon an improvement of yields of rice, wheat and cane. Over large areas in India the yields of rice and wheat have to be increased to three times in amount in order to reach the standards of Japan. The case of cane is even more interesting. In the United Provinces, which is the largest cane-growing district in India, on account of the present low yields on cultivator's holdings, ranging from 300 to 350 maunds per acre, as against 1,000 to 1,200 maunds per acre on Government and big zamindary farms, the same output could be obtained from half the area under cultivation at present in the province, if the propaganda against ratooning and in favour of liberal application of good manures is intensively pushed. The increase in yields of wheat, rice and cane will release millions of acres for the cultivation of beans and pulses, oil-seeds, cotton and hemp, the expansion of which is desirable either for improving the food supply or for making the country self-sufficient in the matter of raw materials of its important growing industries. Cane hardly admits of expansion, as India will be self-sufficient with regard to its supply at an early date; and perhaps the fixation of definite quotas of cane areas by an All-India arrangement will have to be considered immediately. The expansion of beans and pulses will, however, be a significant enrichment of food-supply, having little importance, except in the case of the soya, in the field of export and industry.

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[1] The *arhar*, which is widely cultivated in Northern India, is an instance of a leguminous crop which benefits the soil not only through nitrogen renewal but also through effecting an opening up of the sub-soil by means of its deep root-system.

Throughout the monsoon region the basal crops, rice and millet, are supplemented by beans, pulses and tubers. In parts of the United Provinces, Bihar and Bengal, rice matures in 60 days, i.e., about half the time needed by most varieties of wheat, and thus there is room for a multiplicity of crops. Three crops are raised in North Bihar and even four or five in the deltaic districts in Eastern Bengal, where *boro* rice is sown broadcast in the sandbanks of the Padma and Meghna in April, and reaped before the heavy floods. An arranged succession of croppings is found at its best in India in the active delta in Eastern Bengal. Similarly in Central and South China two crops of rice are grown during the same season. This double cropping is made possible by the long growing season, and by the use of crops maturing before the autumn frosts. In the crop rotation legumes grown in both winter and summer are universally found. The summer rain in the monsoon region is far more favourable to leaf and sap than to bark and fruit, and is definitely unfavourable to stone-fruit and fruit with "bloom"; and the oil and protein and sugar that Europe procures from olive and almond and fig has to come from fibres, pulses, oil-seeds and tubers, especially peas, beans and sweet potatoes."[1] India can learn a great deal from China, which has as many as 12 to 15 crops in some localities in the North. There is far greater diversification of the cropping system in North China than in India. This results, according to Buck, from the desire of the Chinese farmers to reduce the cost of living by becoming as self-sufficient as possible. They accomplish this by raising the many crops that are needed for the use of the family in their own fields. The possible combinations found of the more important winter and summer (second) crops are as follows: in North China, wheat, followed by soya beans, green beans, red beans, cow-peas, sesame, sweet potatoes, millet, carrots, tobacco, buckwheat, Chinese cabbage, onions, hemp, corn, indigo, proso millet and taro; in East Central China, wheat, wheat and field peas (in association), barley, barley and field peas (in association), rape and broad beans, followed by rice, soya beans, sweet potatoes, and corn.[1] These may be compared with the usual crop rotations in Northern and Eastern Bengal, which is a zone of heavy population concentration: summer or winter rice, wheat, pulses (*khesari, matar* and *masur*), or summer and winter rice and *kalai* followed by jute, with or without rice and hemp in the second year, in Northern Bengal; summer rice, gram, *khesari*, jute, and oil-seeds and *kalai*. Land utilisation in India could immensely be improved, in response to heavier population pressure, by the introduction of crop planning from similar climatic and soil conditions in China. The constant association of field peas, vetches and broad beans with wheat or barley or rice should be an eye-opener both for peasants and Government Agricultural Departments in India.

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[1] Lyde: *Continent of Asia*, p. 157.

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[1] Buck: *Chinese Farm Economy*, Chapter VI. Many customary rotations in India in which alternative legumes appear to figure deserve closer investigations than hitherto undertaken. The principle of a legume rotation is also sometimes adopted in India by growing a mixture of a cereal and a pulse such as *arhar* and red grain. The indigenous practice of selection of legumes should provide material for making recommendations of general utility.

Authorities on diet state that amino-acids found in certain legumes such as peas, beans and pulses, or in animal products, supply greater nutritive efficiency than the cereals. The globulins of arhar and field pea, Niyogi and other investigators have found, compare favourably with casein and contain requisite amounts of arginine, histidine, and lysine. These legumes are usually taken with cereals and are useful in supplying the essential diamino acids, especially lysine, in which cereal proteins are usually deficient. The three pulses, lentil, cow-pea and the aconite bean, contain lysine, histidine, arginine, cystine, tyrosine and tryptophane. Their net protein values are 12·86 per cent, 11·05 per cent and 9·04 per cent respectively. Though the net value of proteins of the pulses is found to be only 50 per cent of the total protein content the assimilation can be immensely improved by grinding the pulses into flour before consumption. With the present agricultural organisation in India, the consumption of leguminous products no doubt can be more easily increased than animal products.

THE INTRODUCTION OF THE SOYA

Soya beans in particular, which have been recently introduced into Indian farming, may form a valuable addition to the Indian dietary. This bean is "the magic crop of Chinese agriculture", and has recently expanded extraordinarily in the United States and Soviet Russia. In India the bean is now successfully grown in the Kumaon hills; in Gujerat and Sind soya bean has also been introduced with success. In Sind the bean has grown bigger than in its original home. The protein content of the soya bean is about twice that of meat and eggs and six times that of bread; it contains the three vitamins A, B and D, all of which are deficient in the Indian vegetarian dietary. No pulse, gram or oil-seed contains fats and proteins to the same extent as soya bean. Certain biological tests relating to the nutritive value of Indian pulses have revealed that the soya is the best pulse known so far. It contains more digestible fat than linseed meal. Like other beans and leguminous plants the soya's roots nourish bacteria which can extract nitrogen from the air. Its disagreeable flavour can be eliminated by experimental work in selection and breeding. The improvement of India's national diet in the zones of population pressure is to be sought in a gradual shift of consumption in the direction of peas, beans and pulses and away from animal products.

CHAPTER VII

CROP PLANNING AND NUTRITION

LINES OF IMPROVEMENT OF FOOD CROPS AND DIETARY

Within the limits dictated by regional agricultural practices and food habits there is a great scope in India for improvement both in food crops and in diet. (1) The preponderance of rice in Eastern and South-Indian diet should be reduced. (2) A mixed diet composed of wheat, rice, barley, maize or *ragi* is bound to be better balanced than a diet based on only one staple, e.g., rice or ragi. The consumption of *atta* in rice-eating regions is also to be favoured on account of its higher content in certain minerals such as calcium. Amongst the poorer peasantry of Northern India *bajra* and *jowar* are consumed instead of wheat, and, since the former are much poorer in nutritive value than wheat, the diet is deficient. "But good ragi or bajra," observes McCarrison, "either alone or with rice, when eaten with a sufficiency of milk or milk products or fish and green leafy vegetables and fruits, is one of the best diets used by the Indian races."[1] *Jowar*, like barley, yields a large percentage of malt. Malted *jowar* produced by fermentation, pounded and mixed with other grains for the preparation of *rotis*, or used with milk and butter, is a valuable food. (3) The preponderance of carbohydrates in the form of wheat and sugar should be reduced; and the digestibility of protein elements of the diets improved. It is often found that the vegetable protein, *dal*, is not easily assimilable and causes fermentation. The best Indian *dals* are *arhar* and *mung*. Soya beans represent an important additional source of vegetable protein if taken in relatively small quantities with the cereals. A decided improvement in the use of *dals* would consist in grounding the pulse as far as possible into flour and then consuming it by itself or in mixture with grains or cereals. This would aid both preparation and assimilation. (4) The addition of milk and milk products in various forms is a much-needed improvement, since animal foods are taboo for a large section of the population.[1] The consumption of butter should be preferred to that of *ghee*, which is less easily digestible. Besides, the long standing and heating involved in *ghee*-making lead to the loss of Vitamin A, sadly wanted in the villages, as the occurrence of eye sores and ulcers abundantly indicates. If the use of butter leads to a shortage of *ghee*, oil should be more freely used in cooking. (5) The conservation of fisheries and greater use of fish as a principal article of diet are also indispensable. The use of larger vessels and of power and mechanical appliances in the fishing industry, and of cold storage will greatly increase the supply of fish and lower costs in India. In Japan there has been an increase of 182 per cent in the consumption of fish since 1900; for anxious attention has been drawn there to the relative excess of carbohydrates and the positive lack of protein in that diet by the discovery that the value of the soya bean is greatly modified by an excess of rice.[1] This is also true of Bengal and Madras, where the nutritive value of the *dals* is similarly lost. Throughout India there has been little attempt to conserve and develop fisheries or to regulate fishing in the breeding season. Fishing urgently needs to be regulated by laws that will prevent the use of unsportsmanlike traps and nets, the capture of female fish ready to lay their eggs and the dumping of sewage, oils and wastes into rivers. (6) A greater dependence on vegetables and on fruits would diminish the demand for rice, or of wheat. (7) The quantity of fat is often very inadequate, although the conditions of hard field labour make this element of diet of paramount importance. It is noteworthy that throughout Northern India the consumption of *ghee* and raw sugar is increased generally in the summer months when agricultural work becomes harder than in the rest of the year. (8) The extension of the white potato or sweet potato would give a greater yield of starch per acre than is secured from rice. It is estimated in Europe that potatoes will feed 420 persons per 100 acres, while grass, turned into beef, will feed only 15.[2] Simon reckons that after the introduction of intensive horticulture, France could easily feed from two to four times her present population. (9) A great deal remains to be done in the directions of scientific storage of grain, of refrigeration of fish, meat, dairy products, etc.

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[1] *Food*, p. 78.

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[1] Skimmed milk which is considerably cheaper than whole milk can usefully take the place of the latter. Attention should be directed to the increase of production of skimmed milk in India and its inclusion in the dietary of older children much to the advantage of their health and development. Only 1½ per cent of the total milk produced in India is now utilised for producing Western products such as creamery butter and cheese.

[1] Orchard: *Japan's Economic Position*, p. 19; Lyde: *The Continent of Asia*, p. 696.

[2] See *The New Statesman*, Vol. XXII, p. 538 (Feb. 16, 1924), quoted by E. A. Ross in *Standing Room Only*, page 195.

FALL OF CEREAL PRICES AND THE EXPANSION OF BEANS, PULSES AND OIL-SEEDS

With the loss of India's cereal market abroad and with the increase of population pressure, there is no doubt that the production of wheat and barley will become more and more unremunerative. As a matter of fact intensive investigations in the United Provinces have shown that the percentages of losses are the largest in these crops. Any diminution of the wheat acreage, if continued, would imply a decline of the food and living standards in the wheat-eating regions. Such diminution should accompany the expansion of oil-seeds, beans, potatoes and fibre crops, which can be promoted in many wheat areas. For instance, it should be possible to encourage the cultivation of malting barley, potato, soya, linseed and hemp in the Punjab, the U.P. and the C.P. Another possibility is the cultivation of more vegetable fodder to feed the cattle. In the rice areas, the problem of future food supply will be, first, to find out a better staple which will supplement rice, as China has found in the soya, and, secondly, to encourage the cultivation of quick-growing pulses in semi-wet areas, and of cane, beans, and oil-seeds outside the zone of natural rice lands. While in small quantities pulses form a valuable supplement to the diet mainly composed of rice, the greater use of potato in place of rice is desirable. A diet based on a combination of rice with another cereal is also to be preferred to a diet based exclusively on rice. The present under-nourishment of the poorer sections of the rice zones of India is to be attributed to the high percentage of starch in rice, which so dilutes the protein, e.g., of the *dal*, that the digestion cannot absorb, or even tolerate the quantity which ought to be taken to neutralise the starch. In Japan the chief cause of under-nourishment of the cultivators, according to Grey, is the same preponderance of starch in a rice diet, which so dilutes the protein consumed that extremely large quantities must be taken, thus placing severe strain on the digestive system.

The problem in India would be for the physiologist to find out which peas, grams and beans would be more nutritive and more easily assimilated with wheat or with rice. The *dals* contain about twice as much protein as wheat and four times as much as polished rice. Arhar, mung and gram are the richest in proteins and these should also be kneaded into flour and made into *chapattis* with wheat, barley or other appropriate cereal. Rice, however, cannot be made into *chapattis*. Thus rice-eating peoples exhibit a tendency to take *dal* in large quantities, this leading to indigestion. As India's population pressure increases, the production and consumption of peas, grams and pulses will, indeed, expand in substitution of grains. Such legumes will contribute to replenish soil fertility, add valuable proteins to the dietaries of a vegetarian population and also provide part of the concentrated food for cattle. The total yield of gram in India from 15,822,000 acres was 3,671,000 tons in 1934–1935. The *Kabuli* gram is one of the best types in India, and its introduction and increase of yield may be found useful in different Provinces. Even here the poverty of the cultivators stands in the way of adequate use of *dals*, which is reduced throughout Northern India, where vegetables such as radishes, carrots, onions, brinjals, etc. are available.

In the *Review of Agricultural Operations in India* (1930–1931), we read: "If falling prices for cereals and fibre crops, coupled with the use of higher-yielding varieties of beans and pulses (thus maintaining the same standard of production on a smaller area), leads to an increase in the area under pulses, the eventual gain to the agriculture of the country might be considerable." In Europe the dry farinaceous vegetables, peas of all kinds, beans and lentils, are cultivated especially on the shores of the Mediterranean and in the regions adjacent to the central zone. In France, Italy, Portugal and Spain, where these are used on a large scale, they replace certain amounts of cereals without noticeable disadvantage. The cultivation of these vegetables is combined advantageously with that of wheat and corn both to increase and vary the food resources of the southern zone.[1] With a higher population density in India not only beans and pulses but also oil-seeds yielding vegetable oils and fats will increase in acreage and consumption.

Vegetable oils play an important and varied rôle in foods throughout the world. These serve as equivalents for rather different substances but chiefly as replacements for animal fats in the crowded Oriental countries. In the region contiguous to the Mediterranean olive oil is considered a food of the first order; in Central Europe oils extracted from coniferous plants or from the fruits of the beech and nut trees, and in Eastern Europe oils of sesame, flax, hemp and poppy supplement animal fats. Generally speaking, north of the Alps in Europe lard and oleomargarine are now gradually

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[1] Zimmerman and Frampton: *Family and Society*, part IV; Le Play's *European Studies*, p. 520.

[illegible] lard, margarine and butter. In [illegible] production of oil-seeds has shown no [illegible] and even diminished in some Provinces, [illegible] the increasing population cannot avail [illegible] of an important substitute for animal fat, [illegible] and milk-products, the consumption of which has definitely been reduced among the lower income groups.

Every effort should also be made to introduce into India the soya, which is rich in both fats and proteins, and make rice supplementary to it. The soya flour contains over 41 per cent of protein, while wheat has less than 11; and it contains over 20 per cent of fat while wheat has just over 1 per cent.[1] Taylor observes: "Under usual circumstances more protein can be secured from the unit of land in the form of legumes than in the form of grain, and much more than in the form of meat." He illustrates that the position of soya bean products in the Chinese diet is an illustration of skilful adaptation in covering with available domestic foodstuffs the minimal requirements for the congested population. With a very meagre amount of meal and practically no use of products, the Chinese have lived on what appears to have been a well-balanced diet by the use of the soya bean and other legumes, supplemented with salted or pickled vegetables, pea-nut oil and occasionally fish. Soya bean is used in the preparation of cooking oil, bean curd and other foods. According to a Chinese expert rice polishings and soya-bean cakes, which have never been used as human food except in time of famine,

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[1] Lyde: *The Continent of Asia*, p. 479.

THE NUTRITIONAL IMPORTANCE OF ROOT VEGETABLES

Finally, protein wastage in the dietary due to the formation of ammonia for neutralising acid radicals could be effectively reduced by the addition of adequate quantities of tubers and root vegetables such as potatoes, radishes, beet-roots, onions, *kachus* and ols (collocacia) many of which are not only rich in carbohydrate but also in alkali, Vitamin C and iron, and are also cheap in price. Onion and garlic, apart from their food values, are useful as antiseptic materials. An increased consumption of root vegetables will be useful in yet another way. Some of these, especially potatoes, not only yield more per acre but also require less water for cultivation. Thus the greater cultivation and consumption of root vegetables will be appropriate adjustments to drought conditions in zones of heavy population. It may be noted that some of the pulses popular in the Indian dietary are rich in alkali. *Mung dal* contains the largest quantity of alkali radical, and next in order come kalai, arhar and *masur*.[1] As a cheap dietary, a judicious mixture of rice and wheat with pulses, potatoes and roots and green leafy vegetables which makes the acid and base balance each other, will be much more appropriate for rice-eating peoples as population pressure increases. The fat which is deficient in wheat and rice may be contributed by milk and milk products and vegetable or fish oils.

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[1] N. C. Bhattacharjee: *Food and Nutrition of the Bengalee* (in Bengali).

In the wheat zones, instead of the cheaper millets like bajra such cereals as barley and maize, as well as potato, both sweet and white, gram and soya could be profitably introduced and more largely adopted in the dietary. Bajra bread and sweet potato, barley and jowar, are already indicative of the pressure of population on subsistence in Northern India as the preponderance of rice with an inadequate quantity of *dal* shows the hand-to-mouth existence in parts of Bengal and Southern India. Land might be made to yield more starch in the form of the white potato or sweet potato, which may cut down the production and consumption of rice in India. White potato grows on land too steep and too dry for rice. In the Punjab the various Scotch varieties of potatoes have yielded about 40 maunds more tubers per acre than the local varieties and are of better quality and size. Germany in recent years, with much less intensive methods than are practised in Japan, has been able to secure more starch per acre from potatoes than Japan, for instance, has secured from rice.[1] The possibilities of solving the population and food problem through changes in diet should be intensively explored and widely advertised in India.

Planned crop production must also take into account the relation between the nutritive quality of food grains to soil and agricultural practice. Recent investigations have shown that the wet varieties of rice are not merely heavier in yield but are richer in protein, fat, and potash contents than the dry crop variety. Food grains, root vegetables and fodder crops treated with organic manures are found to be richer in regard to vitamins and other growth-promoting factors than those grown on synthetic manures. Irrigation also has its effects both upon the yield and quality of food grains. Studies in the nutritive quality of crops are, however, just beginning in India, but these should ultimately guide agricultural practice, ensuring at once the combination of high yield with improved nutritive value of food-crops. A systematic crop and food planning, taking into consideration the dual need of producing heavy-yielding and energy-producing crops, supplemented, as these should be, by the accessory food products necessary for health and efficiency, must be undertaken in India especially in the areas of population pressure. It is in these areas that food tends to be inadequate or unbalanced; and planned crop production may offset food deficiency and contribute to improve diet and health conditions and distribute the labour of the peasant families to better advantage throughout the year.

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[1] Orchard: *Japan's Economic Position*, p. 34. Special attention is called to the value of the potato in a recent League of Nations report on nutrition. Potato is rich in calories and starch and is also a valuable source of iron and Vitamin C, and one of particular value because it retains a high proportion of its Vitamin C content after cooking.

CHAPTER VIII

INDUSTRIAL CROPS AND RURAL INDUSTRIALISATION

ECONOMICAL USE OF LAND: FRUIT FARMING AND INDUSTRY.

A successful crop-planning would anticipate an economical use of land in India by increasing the yield of food-crops and reducing of the cost of their production.* This, in turn, would economise man-power and at the same time release millions of acres of land for the expansion of industrial crops like fruits and vegetables of all kinds, cane, oil-bearing seeds, tobacco and fibres. The cultivation of such crops would react favourably upon the standards of farming and living directly and indirectly, if large indigenous manufactures for the disposal of their products could be established; this might draw off the surplus labour from the land.

Fruit farming is already an important industry in many areas of India, carried on in connection with subsistence farming in uneconomic holdings by specialised castes of vegetable gardeners. Near Benares and Allahabad, for instance, fruit growing has been an indispensable support for the agriculturists, who find ready markets for lemons and guavas in the cities and even for wider distribution. In parts of the Doab, Oudh, North Bihar and North Bengal plantations of mangoes are numerous. The export of mangoes from Durbhanga, Bhagalpur and Malda is considerable. Similarly, a thriving mango industry has developed in the Bombay Presidency and an orange industry in the Central Provinces and Assam. Even a common fruit like the banana is cultivated systematically in parts of Western Bengal and the Konkan, and a prosperous export trade exists in the neighbourhood of Calcutta. Fruit growing in the plains of India, however, awaits the development of cheap, rapid and reliable transport, of cold storage facilities at the markets and of methods of preserving the surplus crop, such as jam-making, bottling, tinning and sun-drying or evaporation. India annually imports fruits and vegetables valued at about one crore of rupees. The development of the fruit industry on modern scientific lines will not only add valuable foods to the Indian vegetarian population but will also contribute towards diversification of employment and support of small farming.

SUGAR-CANE FARMING AND INDUSTRY

Apart from Cuba, India with her 3,478,000 acres (1934–1935) under sugar-cane is the largest producer of sugar in the world. The area has increased from 2½ millions in 1929–1930 to about a million acres at the present time; the area under improved canes has increased five-fold. The number of factories has increased, since the grant of protection, from 29 to 145. India now produces 6,200,000 tons of sugar, which is more than twice as much as Java, her competitor in the home market. With 145 factories employing 200,000 workmen India saves about Rs. 1,250 lakhs, the value of sugar manufactured in 1934–1935. Out of this sum, it is estimated, Rs. 600 lakhs go to the cultivators as price for cane; Rs. 120 lakhs are paid for transportation by rail, road and river; Rs. 300 lakhs go to the labourers in the form of wages and Rs. 50 lakhs are paid as salaries. The imports of sugar have decreased from about a million tons in 1930–1931 to only 223,000 tons in 1934–1935. India's yield of sugar-cane per acre, however, still remains low, only about one-third of her total acreage under cane producing improved varieties.

It should be mentioned that in tropical India, where canes suitable for the factory could be grown, cane cultivation is at present unimportant. Outside the tropics India's cane area is concentrated, 75 per cent of the cane area being found in the Indo-Gangetic plain, to the north of the tropic of Cancer; here cane has a very long dry season, so that the indigenous variety is very different from the cane of Cuba, Java or Hawaii from which the refined sugar, i.e., 1·4 tons, of modern commerce is obtained. The yields also are much larger in Madras (6,380 lbs.) and Bombay (6,950 lbs.) than in the United Provinces (2,700 lbs.), where there has been the most considerable development of cane cultivation and sugar manufacture. It may be mentioned in this connection that recently a thick cane grown at Coimbatore, Co 419, has proved most satisfactory among the canes for tropical India. It has exhibited better growth and yield than even the wonder cane of Java, POJ 2878, in certain parts of tropical India.[1] In the whole of India the average yield, however, is only 2,956 lbs. This has recently increased to 3,307 lbs. to the acre as compared with 2 tons in Cuba, over 4 tons in Java and more than 4½ tons in Hawaii. In 1935–1936 the sugar import and production was distributed as follows:—

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[1] *Agriculture and Animal Husbandry in India*, 1933–1935, p. 26.

United Provinces	60·8 per cent
Bihar	25·4 per cent
Other Provinces	13·1 per cent, and
Imports	20·1 per cent

Greater average yield of cane per acre, which can only be secured by better tillage, irrigation, manuring and supersession of the indigenous type of cane, and better average recovery of sugar, which can only result from improved technique and organisation, will firmly establish the Indian sugar industry on sound lines. This would assure remunerative prices to the farmers, provide seasonal employment for a large number of workers, and aid towards a better population adjustment and planning.

IMPORTANCE OF OIL-SEEDS

The development of agricultural industries like the production of vegetable oils and fats, and of cotton mills, sugar, soap, tobacco and hemp factories will divert the floating agricultural labourers and small cultivators; and thus a judicious balance of agriculture and rural industrialisation would be the chief remedy for the excessive population pressure. In the whole of India oil-seeds represent a valuable crop in the dry season and an important item in rural economy. Linseed, rape-seed, sesame and ground-nuts could be greatly expanded in output and thus help to meet the increased food demands of the growing population and establish the manufacture of oils and fats, which have important industrial uses, on a sound footing.

For many years over 20 per cent of India's total exports, in weight and in value, consisted of oil-seeds, after all the home demands were met; and in quality or quantity, or both, India is supreme with half the world's supply of sesame and ground-nuts (Madras), a third of its cotton (Bombay), two-thirds of its rape and mustard (United Provinces), and one-eighth of its linseed (Central Provinces), the best of its coco-nut (Malabar), and 100 per cent of its castor (Deccan). In some cases, the cotton-seed for instance, improved varieties would greatly increase the yield of seeds, though the peasant's need for oil already makes him prefer a variety that yields more seed than fibre.

Owing to the population pressure there has, however, been no increase in production of the four principal oil-producing seeds during the last thirty years. In fact the tendency is towards decrease. Similarly, the exports have fallen. In the case of linseed, exports have tended upwards in recent years, assisted as they have been by the Ottawa Preference granted to India by the United Kingdom. The exports of rape-seed and sesame, which have always been relatively less important than the exports of linseed, have contracted very considerably in volume, and now hold a minor position in India's export trade. When we come to ground-nuts, however, the position is entirely different, both in respect of production and export. From the pre-war period the production has expanded by five and a half times, in fact, this expansion has taken place since the end of the war. Similarly, the exports have increased during the same period by two and a half to three times their pre-war and also their immediate post-war volume. Further, this is not a case of a large percentage increase from a small figure of production and export in the pre-war base period, but from a production of some 600,000 tons and an export of over 200,000 tons valued at 3½ crores of rupees.[1]

The following table compares the quantities of the different kinds of oil-seeds produced and exported, with the pre-war averages:—

	Pre-war Average (in thousand tons)		*Production in 1933–34 (in thousand tons)*		*Exports in 1931–32, 1932–33, 1933–34 (in thousand tons)*		
	Production	*Exports*	*India*	*World*			
Linseed	508	379	376	3,480	120	72	379
Rape and Mustard	1226	273	943	—	54	115	73
Ground-nuts	658	212	3,330	6,261	672	433	547
Castor	—	114	143	—	104	86	82
Cotton	4·4	240	1,839	2,021	12	2	6
Sesame	471	119	541	902	12	10	15
Copra	—	31	—	—	—	—	—
Others	—	85	—	—	14	15	22
Total	1,453				988	733	1,124

NEED FOR DEVELOPMENT OF OIL-CRUSHING INDUSTRY

With heavier population in India it will be uneconomical to grow more oil-seeds for exporting them either raw or in the form of cakes, as this would mean a serious drain of nitrogen. On the other hand, with formidable rivals like the Argentine in the supply of linseed, China in the production of sesame, and Roumania in the supply of rape-seed, with the difficulty of supplying uniform and reliable products for the European industries and with applied chemistry constantly discovering new substitutes for old products, it would be on the whole advantageous to develop a large indigenous oil-crushing industry in the country. The cake would mostly be used up in the fields and consumed by the cattle, while the vegetable oils and fats would support the growing soap manufacture and other industries in the country.

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[1] See *Vegetables, Oils and Oilseeds*, 1936, published by the Imperial Economic Committee.

With increase of industrialisation the Chinese—whose export of soya beans has risen to the first place, amounting to about one-fourth of China's total export trade—press a third to a fourth of the beans before shipment. The oil goes to Europe and America, while the residue is made into cakes and used as a fertilizer or as cattle food. A considerable portion of the cake is also shipped to Japan for use as a fertiliser for mulberry. The local manufacture of oil and oil-cake is a far more economical utilisation of oil-bearing seeds and beans than that which India has adopted. There will be obvious agricultural advantages from utilisation of oil cakes as valuable manures, now lost to the country, which would be available for such crops as sugar-cane, cotton, tobacco and tea, and in the diversification of industry. Oil mills, which now number 205 and give employment to 10,348 hands in India, have greatly increased during the last three decades. In Madras alone the number rose from six in 1921 to 34 in 1931, the number of hands employed being 276 and 900 respectively. Besides these factories there are a number of mills working at a smaller scale throughout India, while in addition the primitive bullock-driven oil-crushing industry is established in large villages of India. India's exports of vegetable non-essential oils are given in the following table. The total trade, however, is small and admits of considerable expansion.

(*In thousand gallons*)

	1913–14 *Pre-war*	1931–32	1932–33	1933–34
Castor oil	1,007	982	1,125	1,335
Ground nut	288	455	917	716
Coco-nut oil	1,091	36	29	32
Mustard oil	407	250	226	263
Other sorts	449	177	147	569
Total	3,242	1,900	2,444	2,915

Among the Indian essential oils sandal-wood is the most valuable and is a monopoly of Southern India, especially Mysore, but it is now facing fierce competition from Australia. The Indian essential oil industry is not yet set on a firm footing. Vetivert, ajoqa, cardamom, coriander, ginger, cloves, etc. and several varieties of fragrant gums and resins are still being exported largely instead of being marketed in India. There is scope for extending the production of such crops by systematic cultivation as is done in some other countries, while the recovery of the essential oils *in situ* is likely, with proper organisation, to prove remunerative.[1]

USES OF VEGETABLE OILS IN INDIA AND FOREIGN COUNTRIES

There is a considerable consumption of vegetable oils in India, and the internal demand will increase with increase of population and the scarcity of *ghee* and butter. A still more important outlet for vegetable oils lies in industrial development. There is a great scope in India for the manufacture of soaps and of vegetable fats. The quantity of soaps imported into India rose from about 250,000 cwts. in 1909–1910 to about 450,000 cwts in 1929–1930. With the establishment of a few soap-factories on modern scientific lines in the country the total imports of soap were reduced to 296,000 cwts in 1932–1933 and 303,000 in 1933–1934. There is also a considerable number of establishments where soap is made by crude methods in India. Since a large section of the Indian consumers object to the use of animal fats, there is great scope for the production of vegetable oils and fats for use in soap manufacture. India also imports annually over one crore of rupees' worth of vegetable *ghee*, vegetable fat, etc., most of which is consumed as edible fats or substitutes for *ghee*. America has applied extensively the hydrogenation process to the lard compound industry, while Europe has applied it in the margarine industry to a large number of vegetable and animal, chiefly marine oils. Factories in India which may render vegetable oils and fats edible by hardening, refining and deodorising, will meet the steady and growing demand for hardened fats both for soap manufacture and as a cheap *ghee* substitute.

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[1] *Census Report, Madras*, 1931.

Vegetable oils have also other uses in industries the establishment of which will lead to the expansion of oil-bearing seeds and the development of remunerative agricultural industries.

The following table gives a list of the chief countries producing oils and oil-bearing materials from seeds exported from India and also classifies the chief uses of oils.[1]

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[1] Zimmerman: *World Resources and Industries*,

Taylor: *Production and Consumption*: *Tropical Agriculture.*

	Uses of the Vegetable Oils and Fats	*Other exporting Countries*	*Importing Raw Material*	*Producing the Oil and Oil-bearing Material*
Linseed	Paint, varnish, linoleum, printer's ink and lithographic ink, patent leather, imitation leather, foundry cores, soap, glycerine, putty, vulcanizing, when cold pressed and refined it is edible	Argentina, Canada, United States,	United States, United Kingdom, Netherlands, Germany, France, Italy, Australia, Japan,	United States, United Kingdom, Netherlands, Germany U.S.S.R.
Rapeseed	Lubricant, illuminant, soap, quenching steel plates	Indo-China,	Japan, United Kingdom, Germany, Netherlands,	Germany, Indo-China, Japan, United Kingdom, Netherlands
Castor	Medicine, alizarine assistant, soap (fine toilet, especially transparent soaps), lubricant for heavy machinery and airplanes, leather preservative, fly paper, illuminant	Brazil,	United States, United Kingdom, France, Belgium	United States, United Kingdom
Cottonseed	Lard substitutes, salad oil, margarine, sardine packing, cooking, medicinal emulsions, soap, washing-powder, glycerine, waterproofing preparations, illuminant	Egypt,	United Kingdom, Ceylon, Egypt	United States, United Kingdom, Egypt
Sesame	Margarine, cooking, enfleurage (extraction of perfume from flowers), soap (Marseilles mottled soap), lubricant, illuminant, rubber substitutes	China,	Netherlands, Germany, United Kingdom, France, United States	Indo-China, Netherlands, Germany, United Kingdom, France, United States,
Copra	Soap (the Cochin oil is suitable for cold-process soap-making). All coco-nut oil makes soaps of good lathering quality. Marine soaps that will lather in hard water may be made from it; "nut" margarine, lard substitutes used by bakers and in the confectionery trades, emulsions, cosmetics, perfumes, ointments, salves	Philippine Islands, Netherlands, East Indies, Ceylon, British Malaya, South Pacific Islands	United States, Netherlands, Germany, France	Philippine Islands, Netherlands, East Indies, Ceylon, India, United States, Netherlands, Germany, France

Taylor: *Production and Consumption: Tropical Agriculture—cont.*

	Uses of the Vegetable Oils and Fats	*Other exporting Countries*	*Importing Raw Material*	*Producing the Oil and Oil-bearing Material*
Ground-nuts	Margarine and edible oils	Senegal, and Gambia, Nigeria, Sudan, Mozambique, Kenya, United States, China, Java	France, United Kingdom, Netherlands, Germany, Italy, Belgium, Denmark	United Kingdom, France

Most of our oil-bearing seeds, as we find in the above table, have to face the increasing competition of other agricultural countries and from similar products, the supply of which has also been increasing rapidly. The recent world depression in agriculture has also resulted in the falling off in the demand for cattle-feeding stuff, which has distinctly lowered the price of and demand for oil-seed, cake and compounds made therefrom. The establishment of a large oil-crushing industry is so important in India for prevention of the annual economic drain in the form of loss of oil-cakes possessing inestimable value as fertilisers and cattle food and oils, which might, if properly manipulated, prove of use for soap, colour, paint, varnish and the linoleum industries, that it is necessary to shepherd the new and growing industries by the imposition of an export duty on oil-seeds and oil-cakes. The manufacture of cheap *ghee* substitutes would also be important from the standpoint of the Indian dietary, the price of *ghee* at present being too high to be used normally in the peasant's household.

Development of the Tobacco Industry

Tobacco is also one of the most valuable crops cultivated in India, which supplies about 40 per cent of the total quantity of world production. India, however, is very far from capturing a proportional share of the tobacco industry. There has been a steady increase in tobacco cultivation during the past five years with about one-third increase on the pre-war average. The export trade of tobacco was 29 million lbs. in quantity and Rs. 90 lakhs in value in 1933–1934, the largest purchaser being the United Kingdom. India, on the other hand, imported 4·2 million lbs. of unmanufactured tobacco and foreign cigarettes amounting to ·6 million lbs., valued at Rs. 19 lakhs. This represents a much lower figure than in 1929–1930 when the imports of foreign cigarettes represented Rs. 213 lakhs. This decrease in the value of foreign imports could be explained by the rise of the tobacco industry coupled with Swadeshi and boycott. In 1932 there were 25 tobacco factories in India employing 5,769 persons. The number of flue curing barms in India for the production of light bright leaf was estimated at 775, of which 700 were in Madras, 60 in the United Provinces and the remainder in North Bihar. The production of tobacco similar in colour and flavour to the Virginian tobacco, which India imports mostly from the United States, will be an important aid in the development of the tobacco industry for which the home market is represented by the annual consumption of cigarettes to the extent about 6,500 millions.

Tobacco improvement should be undertaken along three lines: (1) the production of a tobacco which could meet the requirements of cigarette factories in India and thus lead to the diminution of imports of the Virginian leaf; this might also lead to the production of high-grade pipe tobacco in the country; (2) the improvement of cigar tobacco grown in India; (3) the improvement of strong flavoured Indian tobacco used in the *huka* and for chewing and snuff.[1]

FIBRE PRODUCTION AND MANUFACTURE

Among the fibre crops jute, cotton, hemp and silk are important. As regards jute it appears that both production and export have reached saturation points for the present at least, and until new uses of jute are forthcoming any expansion in the world market in jute cannot be hoped for. The Jute Enquiry Committee recently recommended the extension of voluntary restriction of jute cultivation and suggested that the land set free by restricting jute cultivation could be most profitably utilised in the cultivation of rice, sugar-cane and finer varieties of tobacco. The Committee have found jute meeting with competition which is developed along two main lines: (*a*) progressive elimination of jute sacks as containers for grain in transit owing to increased adoption of bulk handling; (*b*) substitution of jute by paper, and to a less extent by cotton, for the making of bags. The danger is real and the remedy lies in putting forth every effort to retain trade which the industry now holds; and in initiating and vigorously pursuing a policy of research with the object of discovering fresh markets and new uses for jute. Agricultural research should continue with the object of obtaining new strains of jute which may give better results either in the matter of yield, or quality, or both.

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[1] See *Tobacco and Its Preparations, by a Specialist*, p. 22.

The trend of cotton production has been a definite increase, especially in the six or seven years ending 1929. The highest figure reached was 121 lakhs of bales (of 400 lbs. each). Since then there has been a decrease. From a quinquennial average of 25 million acres, the area under cotton has now dropped to 22·5 in 1932–1933. Such decrease of cotton cultivation has been due to unfavourable seasons, increase of cane cultivation, cheaper cotton prices and the damage from the pink boll worm. India now imports certain grades of longer staple cotton which she cannot produce in sufficient quantity to meet her requirements. Both the pre-war and post-war averages of raw cotton imports were 12,000 tons, but in 1932–1933 the figure reached was 85,000 tons. There is thus large scope, with the extension of irrigation, for the improvement both of the quality and yield of cotton. Only about one-seventh of the total cotton area in India is under improved varieties. Longer stapled varieties can be grown successfully in the irrigated areas of the Punjab and Madras.

Sann hemp occupies in India some 6½ lakhs acres annually. Though a considerable proportion of the production is consumed locally, the export trade is of considerable value, representing 281,000 cwt. in 1932–1933. Method of retting and preparing the hemp fibre have to be improved if Indian hemp can maintain its position in foreign markets in competition with the Naples and the Russian supply. Manilla hemp is also a powerful competitor of India, especially in the British market.

The production of silk was formerly of great importance in Indian agriculture. Some of the finest silks in the world were formerly obtained in the villages of Murshidabad and Maldah, where mulberry cultivation and cocoon rearing reached high standards. Sericulture and silk-weaving ought to be revived wherever conditions are favourable, and this would add an important subsidiary cultivation and industry for the Indian peasants. It is well known that both China and Japan produce silk of great importance in their export trade and cocoon production, and silk reeling and weaving are important bye-occupations for the small farmers in those countries.

Industries, large, medium-sized or small, are the most important means of relieving the present heavy pressure of population on the soil. India's pace of industrialisation is exceedingly tardy. In any system of industrial planning in India it is essential to stress the important rôle of those industries in particular which are distributed nearer the sources of the raw materials and offer facilities to the peasants to obtain remunerative prices for the cultivation of raw materials and industrial crops, which may supplement their subsistence cropping.

CHAPTER IX

THE TRIANGULAR CONFLICT: MAN-LAND-CATTLE

POPULATION PRESSURE AND THE PREFERENCE OF VEGETABLE FOODSTUFFS

The man-land ratio has contributed to the exclusion of foods of animal origin in India. For the last few decades milk and milk-products yielded by the cow, the mother of the ubiquitous and irreplaceable bullock, have strikingly diminished in consumption; and this has resulted in a serious impoverishment of the diet of the peasantry. Yet the value of the present milk output of 700–800 million maunds in India is estimated as much nearer Rs. 400 than Rs. 300 crores a year, and is larger than the estimated value of cattle labour from Rs. 300 to Rs. 500 crores and of cattle manure worth about Rs. 270 crores.

Of all parts of India the Punjab and the North-Western Frontier Province show the largest consumption of animal products in the dietary.[1] But even in the Punjab the bulk of the food constituents and energy values is drawn from the vegetable products. Kartar Singh, who collected a number of family budgets from Lyallpur in the Punjab, gives the following table showing the relative importance of animal and vegetable products in the Punjab diets.[2]

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[1] For the Punjab diets see Halliday: "Diet in the Tropics," *Practitioner*, Vol. CXIV, 1925.

[2] It appears that Kartar Singh's family budgets are rather exceptional, yielding, as these dietaries do, such a high food value as 4,414 calories, as compared with Lt. Col. C. A. Gill's figure, only 2,347 for the Punjab labourers and 2,847 for the Punjab prisoners (See Note regarding Food and Diet by Gill, *Royal Commission on Labour, Evidence*, Vol. II, Part I).

	Proteins	*Fats*	*Carbohydrates*	*Energy*
1. Animal Products (meat, milk and milk products)	25·8	75·0	3·6	14·9
2. Vegetable Products, (grain, sugar, fruits and vegetables)	74·1	24·5	96·2	84·9
3. Miscellaneous	0·1	0·5	0·2	0·2

The lower percentages of both calories and proteins derived from animal products than those obtained from vegetable products is due to the fact that a large consumption of the former is incompatible with the economical use of small-holdings. That vegetable products give more of food values is shown by the following figures giving the amount of various constituents in each class of food purchased for one rupee in Lyallpur.

	Proteins	*Fats*	*Carbo-hydrates*	*Energy*
Animal Products	0·70	1·01	0·68	13,633
Vegetable Products	1·10	0·18	10·02	43,037

To produce 1,000 calories in the form of milk requires two and a half to four times as much land as to produce 1,000 calories in the form of wheat, rice and other cereals. Similarly, fruits and vegetables and particularly meat and beef, give in general a much lower caloric return per acre than cereals and root vegetables such as potatoes. The following table, recently prepared by the U.S. Department of Agriculture, gives a comparison of the acreage needed by vegetable and animal foodstuffs to produce a given number of calories:

ACREAGE NEEDED TO PRODUCE 1,400,000 CALORIES

	Number of Acres		*Total*
	Crop	*Pasture*	
Potato	0·76	—	0·76
Corn meal	0·79	—	0·79
Wheat flour	1·45	—	1·45
Milk	2·35	1·60	3·95
Pork and lard	3·70	0·70	4·40
Beef	11·30	2·50	13·80

Owing to excessive agricultural protection, several European countries, despite increasing population, have shown a considerable reduction in the calorimetric value of food and the preference of bread and potatoes to meat, fruit, vegetables and dairy produce.[1] Thus the clearly marked evolution of consumption of food-stuffs and better nutriment in the direction of variety, marked for the last half century, has been checked.

The difference in caloric yield of various foods per unit of land is also reflected in their prices, as for instance in the Punjab table. The reason, therefore, why the Eastern countries ordinarily do not and cannot favour animal products cannot be exclusively religious. Vegetarianism is ultimately a result of a heavy population pressure.

What Buck has observed about the Chinese dietaries accordingly holds good also of the Indian dietaries: "Greater amounts of such animal foods as dairy products and eggs introduced as a new industry would diversify farming, but might be less economical of the land, except in a very limited way. While it remains to be proved that all the necessary essentials of a good diet can be obtained from the vegetable kingdom, still the evidence points to such a probability. If so, then the advantages to be had from the raising of animals depend largely upon their economical utilisation of bye-products and on their place in soil fertility maintenance." As a matter of fact McCollum and Simmonds have found that diets made up of a mixture of maize, alfalfa leaf and cooked peas, subsequently dried, have led to considerable growth and reproduction and must be regarded as satisfactory. Leafy vegetables (*saks*), which are largely consumed in India, contain iron compounds which help towards an adequate oxidation of food-stuffs in the system. Observation shows that in the West meat is absent entirely from the menus of certain categories of workmen who are endowed with vigour and energy, whereas none have been found who abstain permanently from the use of fats or milk. In many agricultural districts of France, Italy and Spain the populations eat meat once a year, on the day of the patron saint.[1] In the crowded countries of the East man can afford but small additions of meat, fish, poultry or egg to his diet, consisting in great measure of vegetable food, including the leafy vegetables whose nutritive values the West has never learnt to appreciate.[2]

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[1] *World Economic Survey*, 1934–35, p. 89; *The Agricultural Crisis*, Vol. I, p. 16.

MAXIMUM LAND UTILISATION

As population pressure increases there is a tendency everywhere not merely to use more carbohydrates than proteins, since the former are cheaper, but also to supersede all dairy products, animal foods and fruits; and this often causes an unbalance which is particularly characteristic of the poorer sections and communities. It must be conceded that the Indian dietary involves a minimum land requirement, about 97 per cent of the food energy consumed by the peasant family being derived from seeds, roots and vegetables. The following table gives a comparison of the sources of food energy for the peasantry in India, China and the United States:

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[1] Zimmerman and Framton: *Family and Society*, section on European Studies, p. 518.

[2] McCollum and Simmonds: *The Newer Knowledge of Nutrition*, p. 170.

PROPORTION OF CALORIES FROM DIFFERENT CLASSES OF FOOD[1]

	The United Provinces	*The Punjab*	*China*	*United States*
Seeds	93·6	75·1	89·8	38·7
Roots and Vegetables.	3·8	0·3	3·9	9·0
Animal (meat and fish and dairy produce) .	0·7	14·9	1·0	39·2
Sugar	0·1	9·2	0·2	10·1
Fruits	0·1	0·3	3·2	3·0
Fats (Vegetables) .	1·7	0·2	1·8	—

On the basis of an optimum peasant's diet (providing for an adult at least 2,500 calories and 75 grains of protein) and the agricultural production per average holding in the United Provinces (from which deductions have been made for wastage, seed and cattle food), we have estimated that 10 acres can support 11 adults or about 16 units (comprising women and children also). This may be compared with Middleton's estimates for England and Germany.

RELATION BETWEEN CULTIVATED AREA AND POPULATION

(*Food-yielding capacity of* 100 *acres*)

India	100 to 110 persons
Great Britain	45 to 50 persons
Germany	70 to 75 persons

The above will explain how such a rural density at least four times that in the agricultural tracts of Europe can be supported by agriculture in India. Much of India's advantage is due to double-cropping;

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[1] The United Provinces results are derived from a recent survey in Gorakhpur by A. C. Bose. The Punjab figures are those of Kartar Singh, and the Chinese and American figures are given in Buck's *Chinese Farm Economics*, p. 364.

while the superiority of German to British agriculture is due to much higher proportion of arable to grassland and a dietary in which the energy is obtained more economically, i.e., from potatoes compared with meat, and in meat from pork than that from beef as in Great Britain. In India the advantage is due to double-cropping which is made possible here as well as in China by the long growing season under conditions of summer rainfall, as well as to the complete omission of animal raising and dependence on a vegetarian diet based on seeds, roots and leafy vegetables. Where hand-cultivation is seen at its best, as in the case of rice, India's yields are high, though much lower than in China and Japan, but these are otherwise low as compared with crop yields in other countries.[1]

	Rice		*Wheat*		*Corn*	
	Acreage (Millions)	*Yield (Bushels)*	*Acreage (Millions)*	*Yield (Bushels)*	*Acreage (Millions)*	*Yield (Bushels)*
India	81·4	863	29·6	11·4	5·9	13·9
China	50·0	1,750	50·7	10·8	8·0	11·7
Japan	7·7	2,350	—	—	—	—
Rumania	—	—	39·1	10·1	5·3	17·4
Italy	—	—	11·5	17·2	3·8	24·9
United States	·9	1,076	58·1	13·9	102·8	27·8

Thus in India, as in China, the output per acre is higher than in Europe but the output per worker is invariably lower. Indian crop yields can be at least doubled by the use of improved seeds and methods of tillage, fertilisers and by the utilisation of idle or semi-idle labour.

FEEDING REQUIREMENTS OF CATTLE

It will be interesting now to examine the relations between human and bovine population pressure.

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[1] Tawney: *Land and Labour in China.*

The gradual expansion of cultivated area and the almost complete conversion of pastures into tilled lands in the congested areas of India have resulted in the impoverishment of cattle. The heavier the population, the smaller is the holding in India. The inability to devote any but a mere fraction of the tiny holding to fodder crops aggravates the fodder shortage, which becomes a serious fodder famine two or three months before the monsoon in considerable parts of India. The triangular problem of food supply is illustrated in the United Provinces, for instance, by the fact that about a million animals graze over only 5,000 square miles in the forests of the United Provinces. The forest area represents only 5 per cent of the total area of the province and aids very little in meeting fodder requirements since less than one million of the 32 millions of cattle ever go near the forests. Of the total net cultivated area of 295 million acres in India, 251 million acres grow food-grains. Only 10 million acres represent special fodder crops. The majority of the Indian cattle obtain their requirements from whatever grazing is available, from straw and stalk and other residues from the human foodstuffs, and are starved seasonally in the dry months when grasses whither.

The following table gives the feeding standards of live-stock in India:

FEEDING STANDARDS

(Pounds per Head per Day)

Live Weight	*Maintenance (at rest)*		*Work (eight hours' ploughing*	
	Digestible Crude Protein	*Starch Equivalent*	*Digestible Crude Protein*	*Starch Equivalent*
600	0·26	3·6	0·86	6·8
800	0·31	4·6	1·00	8·5
1,000	0·37	5·7	1·21	10·4

The nutritional values of the important Indian feeding stuffs for the live-stock are given below:

Available Nutrients in 100 *lbs. Dry Matter.*

Fodder	*Protein*	*Organic Matter*	*Starch Equivalents*
Jowar (young grain)	6·40	63·02	49·5
Jowar Hay	4·75	56·78	40·3
Wheat Straw	0·41	37·55	13·6
Rice Straw	0·26	44·93	23·1
Ragi Straw	0·05	54·88	37·7

Fodder of about equal Nutritive Values.

		Minimum Requirement
Wheat Straw	10 lbs.	8⅓ seers
Rice Straw	6 lbs.	5 seers
Jowar Straw	6 lbs.	8⅓ seers
Hay Straw	8 lbs.	6⅔ seers

INVERSE CORRESPONDENCE BETWEEN CATTLE DENSITY AND CROP AREA PER CAPITA

It is needless to state that in the United Provinces, Bihar and Orissa, and Bengal, the cattle cannot obtain their minimum feeding requirement at all. The competition of both the human and bovine population for maintenance on small-holdings which must yield both food and fodder crops has resulted in the steady deterioration of animals' food supply and of their breed and efficiency. One might expect that heavy population density thins out bovine population. But it is one of the striking economic paradoxes in India that the Provinces which have the smallest crop area *per capita* maintain the largest numbers of cattle. In fact the density of bovine population per crop area varies directly with human population density and inversely with the crop area per person.

In China, and particularly in Japan, the struggle for human subsistence has, as we have seen, crowded out all but draught animals and types such as pigs and chickens which forage for themselves. In Japan, where about 5½ million farming families cultivate roughly 15 million acres, a little under 3 acres per family, the number of cattle is exceedingly small, only 1,512,000; pigs, goat and sheep forming another million. In India the animal population is excessive and the uneconomical maintenance and multiplication of useless superfluous cattle, due to religious and humanitarian considerations, represent a problem which baffles the efforts of all social and economic reformers.

INDIA'S SUPERFLUOUS CATTLE

Agriculture in India, as elsewhere, is economically impossible if the fodder of the working animals must be bought; and the farm must provide it, either in the shape of fodder crops, or of the bye-products of other crops, the straw and stalks (principally those of the jowar, bajra, maize and now of sugarcane and the straw of wheat and gram) which form the bulk of the fodder supply. The result is a close interrelation between the size of a holding, the class of crops grown, and the number and quality of the cattle employed; and it is this which accounts for the violent contrasts between the cattle in different tracts, from the costly and powerful animals of large holdings in the Punjab canal colonies, the upper Ganges Doab or North Gujerat, to the miserable half-starved beasts in the rice tracts of Bihar, Bengal and Orissa. In the latter areas the cattle are much smaller, the holdings are smaller and the number of plough bullocks kept is larger. In wheat, cotton and millet zones of India the total number of cattle lie between 20 and 30 per hundred acres of net area sown with from 8 to 10 plough cattle, whereas where the rice is the predominant crop between three or four times the number is expected. No doubt the following comparison of the number of cattle kept in India with those maintained in other countries indicates the possibility of reducing the number of working bullocks without lowering the standard of cultivation:

NUMBER OF CATTLE PER HUNDRED ACRES OF SOWN AREA

Bengal	108
Bihar and Orissa	89
The United Provinces	91
Madras	75
India	67
Holland	38
Egypt	25
China	15
Japan	6

It is probable that the number of live-stock could be safely reduced in the whole of India to one-third of the present population without affecting the standard of farming and rural transport. The following table shows the increase of Indian live-stock during the last 20 years:

In Millions

	1912–13	1926–27	1934–35
Cattle and Buffaloes	152·8	187	214·2
Sheep and Goats	59·7	87·5	95·6
Horses, Ponies, Donkeys and Camels	3·8	4·9	5·1

The total population of domesticated animals, about 315 millions, is 60 millions less than the total human population of India. Of these, 125 million heads of cattle may be regarded as uneconomical and superfluous. The present bovine population of India is more than one-third of the estimated total bovine population of the entire world.

MULTIPLICATION OF CATTLE TO COUNTERACT INEFFICIENCY.

The increase of the cattle population in India decade by decade in the present fodder situation suggests a vicious circle. This was observed by Royal Commission of Agriculture: "The number of cattle within a district depends upon, and is regulated by, the demand for bullocks. The worse the conditions for rearing efficient cattle are, the greater the numbers kept tend to be. Cows become less fertile and their calves become undersized and do not satisfy cultivators, who, in the attempt to secure useful bullocks, breed more and more cattle." This may be vividly illustrated by contrasting the conditions of fodder cultivation and cow-keeping in Meerut and Bulandshahr on the one hand and Gorakhpur and Basti districts on the other. The figures are those of the Cattle Census of 1930, in which it was estimated that 3 seers of milk per day from a cow and 4 seers from a cow-buffalo represent yields which are economic minima.

	Average Holding	*Percentage of Average Holding to Economic Holding*	*Percentage to the Net Area cropped of*		
			Fodder Crops	*Wheat*	*Rice*
Meerut	6·7	126	15·2	33·3	1·3
Bulandshahr	6·7	126	·26	21·6	·3
Gorakhpur	4·3	107	1·1	20·5	40·6
Basti	4·3	107	1·9	24·1	48·4

NUMBER PER 100 ACRES OF NET AREA SOWN OF

	Cows Giving 2 Seers of Milk or More	*Other Cows*	*Cow-Buffaloes Giving 4 Seers of Milk*	*Other Cow-Buffaloes*
Meerut	4·9	4·4	11·6	2·9
Bulandshahr	4·1	4·1	11·8	4·2
Gorakhpur	0·2	17·7	0·6	6·5
Basti	0·08	19·5	0·3	9·5

In the Doab climate and social tradition have evolved an efficient mixed farming, a moderate number of live-stock being maintained by fodder cropping. Fewer but more efficient cattle in the Doab provide nutrition for the people, help materially to maintain soil fertility and increase its total output for the cultivators.[1] In the eastern districts of the United Provinces, on the other hand, the more considerable proportion of cattle are useless and their multiplication implies a progressive deterioration of breed of cattle and economic position of the cultivators. In the United Provinces only about 6·8 per cent of cows yield 3 seers of milk per day and 26·5 per cent of the buffaloes yield more than 4 seers of milk. Out of such cows and buffaloes 75 per cent belong to Meerut and Agra divisions. As regards bulls, there is only one bull to 263 cows in the Province, while the Report of the Royal Commission on Agriculture mentions one bull to 56 cows as the conservative demand. Bulls are decreasing owing to scarcity of fodder, disease and decline of the practice of dedication. In the Sub-Himalaya East, which includes Gorakhpur and Basti districts the number of bulls declined by 23 and 30 per cent between 1920–1925 and 1925–1930 on the figures of the 1920 Census, while in the West Indo-Gangetic Plain, these increased by 22 and 16 per cent.[2]

An intensive investigation of the cattle population in the district of Sitapur, in Oudh, has shown certain striking results which are typical of the zones of heavy concentration in India.[3] Since 1891 the total cattle population increased in the village surveyed from 338 to 357; cows and bullocks increased from 101 to 196 and plough bullocks and buffaloes from 120 to 330. On an average 209 bullocks are employed in cultivating 100 acres of land. The economic minima have been estimated to be 1 acre in the case of light soil and three-fourths of an acre in hard soil in Bengal, which a pair of bullocks working eight hours a day should cultivate. The distribution of bullocks on the basis of the area of land they plough in a day is shown below:

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[1] Baljit Singh: *Agricultural Progress in the Upper Doab* (unpublished manuscript).

[2] *United Provinces Census Report*, 1931, pp. 34–35.

[3] The investigation was carried on under my supervision by my pupil, Mr. P. Upadhaya, M.A.

	Percentage of Bullocks in Pairs
Ploughing ·2 acres	14·6
Ploughing ·2 to ·3 acres	19·8
Ploughing ·3 to ·4 acres	31·9
Ploughing ·4 to ·5 acres	21·3
Ploughing ·5 to ·6 acres	10·0
Ploughing over ·6 acres	2·4

Not merely are the majority of the bullocks superfluous but out of a total number of 142 cows 114 are found unproductive. Twenty-one of these yield half a seer, 5 yield up to 1 seer and only 2 over 1 seer of milk per day. Out of 54 cow-buffaloes, however, only 3 are found unproductive, 4 yield milk up to 1 seer, 30 between 1 and 2 seers; 9 between 2 and 3 seers and only 1 over 3 seers of milk per day. There is chronic starvation on the part of the cattle, which accounts for on an average of one-third of the total cattle mortality. Many plough bullocks are sold off in winter, or their rations are ruthlessly decreased whenever they are not worked in full, while the milch cattle are kept on after lactation, solely on poor and inadequate grazing. On the other hand, scrub bulls are allowed everywhere to cover heifers, which are generally immature, so that the herd multiplies although many of the animals do not get a chance to live. In considerable parts of India which are hot and dry the dry weather leads to such diminution of supply of fodder grass that except in tracts adjacent to grazing areas or where migration to distant pastures at certain seasons is possible there is virtual starvation of cattle. Even in the wet parts of India the grass is so coarse and becomes so deficient in nutriment in the hot weather that the beasts have seriously deteriorated. These hardly produce sufficient return from milk or from the production of work animals and rightly fetch but little for slaughter. Particularly in the zones of heavy human concentration do these represent a serious chronic drain on the very limited resources of small farmers.

CHAPTER X

CATTLE CRISIS AND DETERIORATION

Better Breeds in Regions of Inadequate Rainfall

It is one of the striking paradoxes with which we are familiar in economic life in India that while she has a total cattle population of 214·2 millions, her working cattle, numbering about 60 million, fall far short of her demand for draught power. India's total cultivated area is about 300 million acres. A pair of bullocks to 10 acres of arable land is hardly sufficient for careful tillage in considerable parts of the country. In most Provinces it is the useless and uneconomical stock which forms a large and increasing proportion of the animal population. Another curious paradox is that most of India's superior live-stock come from those parts where rainfall is low, water supply scarce and grassland resources deficient. With the development of irrigation and expansion of the cultivated area, grazing areas are reduced everywhere and animals coming from the irrigated zones are much inferior in condition, so far as their performance is concerned, while they are more susceptible to parasitic infections and disease in general. In the tracts of heavy rainfall the phenomenal concentration of human population has also led to the invasion of all grass-lands and pastures by the plough and has made fodder scarcer and scarcer, and probably both climatic and nutritional causes account for the deterioration of the local breeds. In the Ganges Valley as we proceed eastward the rainfall becomes heavier, population increases and the cattle become punier and lighter in weight. Both a chronic fodder shortage and moist hot climate result in a rapid deterioration of the stocks, which leads the peasants to multiply more and more of the superfluous, under-developed beasts. Thus while in the dry areas where natural grasses are deficient the stock-owners maintain a moderate bovine population, supplement fodder by valuable foodstuffs and carry on a remunerative business by selling the animals and their products, in the moist areas both human and bovine population multiply indefinitely, jeopardising the health and welfare of both and gradually narrowing their economic base. Due to the excessive burden of the animal population and the intensive grazing, browsing and lopping, the vegetation over large tracts of Northern India has reverted to the bush and scrub jungle and coarse grass type from which the live-stock cannot derive an adequate sustenance.[1]

EFFECTS OF MALNUTRITION AMONG CATTLE

Investigations clearly indicate that the existence of goitre, osteomalacia and other bone troubles, emaciation, birth of weak calves and pica are due to malnutrition. At Coonoor, animals living on imperfect diets have shown a greater tendency to infections of the respiratory and gastro-intestinal tract, and of stone-formation in the bladder. A great loss of body calcium is a predisposing factor in the greater incidence of certain diseases in heavy milking cows such as milk fever, tuberculosis and Johne's disease. The latter is now rapidly spreading in India. Other types of losses, such as those resulting from irregular breeding and abortion of non-infectious origin, which are quite common in India, are also probably due to faulty dieting on a calcium and Vitamin A deficient ration.[1] Vitamin A deficiency in the diet of cows is also found to produce blindness among calves. Prolonged malnutrition or famine leads to the suppression of oestrus. Thus in India in the drought years village cows do not bear calves, or bear them only in alternate years or even only once in three years when the body reserves for minerals and other essentials are re-established.

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[1] Mukerjee, *The Regional Balance of Man*. Chapter VI.

As numbers of cattle increase or as the increase of tillage encroaches on the better grazing land, the pressure on the available supply of food leads to further poverty in the local breeds, and a stage is reached when oxen from other Provinces or male buffaloes are bought in to assist cultivation as in Bengal.[2] Weight for weight, a small animal consumes a much larger quantity of food than a bigger animal. Thus an animal weighing 500 lbs. is estimated to consume not half but about two-thirds of what an animal weighing 1,000 lbs. would consume. Thus real improvement can come only from raising the quality and limiting the quantity.

UNPARALLELED INCREASE AND DETERIORATION OF CATTLE IN BENGAL

In many districts in Bengal the land is never ploughed until a good shower of rain has softened it. This explains also why cows are sometimes yoked to the plough and the miserable animals of the delta appear to do as much work as the finer beasts of the United Provinces. Every available inch in Bengal, it might be said, of the land that is fit for cultivation and not required for human occupation is brought under the plough or planted with fruit-bearing trees. Public grazing grounds have almost disappeared. The absence of grazing facilities in some of the overstocked districts is indicated by the following table deduced from the Cattle Census Report of Bengal of 1915.

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[1] K. C. Sen: "The Nutrition of Indian Cattle," *Agriculture and Live-Stock in India*, March, 1935.

[2] Bengal imports bullocks from outside costing her Rs. 50 lakhs annually.

District	*Number of Animals per Acre of Grazing*
Faridpur	69
Noakhali	55
Howrah	45
Bogra	40
Tippera and Rangpur	35
24 Parganas	30

Over and above this there are the shortage of grazing nutriment and deterioration of the grasses due to the uncontrolled and excessive use for decades. Of a total cropped area of about 31 million acres in 1915 only 0·1 million acres were under fodder crops. The staple fodder in Bengal was paddy straw from about 23 million acres. In a Government Report we read: "Even if the whole of this straw were made available as cattle food (it is well known it is not) the supply would be insufficient for the barest requirements. It works out at about 2 seers per day, whereas the normal consumption should be about 5 seers[1] Taking three districts in the order of their agricultural decline, viz., Hooghly, Burdwan

	Oxen		*Buffaloes*		*Ploughs*	
	1920	1930	1920	1930	1920	1930
Hooghly	467,801	515,870	4,464	5,158	75,943	72,201
Burdwan	907,369	925,481	10,737	54,371	129,149	134,317
Jessore	828,830	1,063,659	16,155	11,803	177,028	177,021

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[1] *Nutrition of Cattle in Bengal*, p. 2.

and Jessore, we find that between 1920–1930 the live-stock have yet increased phenomenally.

Every pathway or cattle track is narrowed down by the cultivator whose field is on either side, until barely room is left for two persons to pass each other on foot. The banks of tanks and the slopes of the embankments of public roads are the only grazing-grounds and the cattle subsist mainly on paddy straw, paddy-husks and the coarse grass which grows in tanks almost silted up. Just after the rice crop has been cut they get enough to eat, but at other times of the year they are half-starved. The lack of sufficient pasture, the absence of good fodder and the inability of the peasants to stall-feed their beasts have led in Bengal to a deterioration of cattle unparalleled in the rest of India. As cattle become smaller the cultivator increases their numbers to offset their inefficiency. On the other hand, as the cattle become smaller the amount of food needed in proportion to their size increases. For it must not be supposed that the food required by 100 small cattle is the same as that needed by 50 double the size. All this accelerates the rate at which the conditions become worse for both the breeding and maintenance of good live-stock.

ECONOMIC FOLLY IN INCREASING SCRUB CATTLE

The live-stock is thus fast and progressively increasing and deteriorating not only in many districts in Bengal but also in the densely populated parts of Orissa and Madras, in the eastern districts of the United Provinces and in north and south Bihar. Economic folly cannot go further. But the folly is being repeated by small-holders who have the [illegible] that drain on [illegible] resources. The small-holder has his [illegible] way of meeting the fodder shortage; he sells his cattle in the beginning of summer, as soon as he can spare them, and buys new ones as the agricultural operations begin, thus avoiding the expense of feeding them at the time when fodder and grazing is shortest. *But this sometimes involves great loss for him and profits for the peripatetic cattle-dealers* who swarm about in the countryside when the monsoon begins. In India, as a whole, the bovine population increased from 152·8 to 214·2 millions between 1912–1913 and 1934–1935—an increase of 45 per cent in two decades. The major portion of this increase comes from small cultivators in the zones of human concentration where the majority of the holdings are uneconomic.

With a chronic fodder shortage, the offspring from the under-fed and under-bred animals become progressively poorer in each generation. The only redeemable feature recently found by the Punjab Government—if it can be considered so—is that these scrub cattle are almost immune to the ordinary live-stock diseases and to the periods of particular shortage of grass in drought years—traits which would decimate the better-bred stock. Thus no improvement of the breed of cattle is possible unless the chronic fodder difficulty is solved, and its solution is rendered more and more difficult by the multiplication of scrub cattle. In the Punjab Report we read, "If the scrub cattle are 'bred up' (improved) by the introduction of good bulls of foreign breed, and the half-bred progeny have to compete for the present inadequate ration of fodder, they will fall an easy prey to disease and drought, because they will have lost some of their mothers' hardiness and immunity." Thus does the vicious circle extend, including in its expanding ambit cattle, crops and men.

Since fodder and pasturage are deficient large numbers of inefficient cattle which are preserved in a state of semi-starvation consume fodder that is sadly required for the better cattle. Overgrazing leads to the deterioration of the grass-lands, erosion of their surface soil and the loss of nutriment value of the fodder, which often acquires harmful quality on account of deficiency of certain mineral contents such as phosphorus and auximones. On the other hand, surface tillage due to the lower strength of the cattle and inadequate manuring lead to deterioration of arable land. Malnutrition thus pursues its harmful course in an ever-widening vicious circle; the cultivator is too often ill-nourished and ravaged by disease which is commonly the result of his ill-nourishment. Obviously, the poorer the beast is fed, the poorer in food-value must be its produce. In most districts of the Punjab the physicians generally agree that at least half the prevalent illnesses are due to malnutrition, caused by the dairy produce being poorer in essential body-building chemicals than it ought to be.[1] It must be remembered that the dairy animals are better fed in the Punjab than in most Provinces of India. Throughout India the cultivator and his animals are in competition for the sustenance which can be grown on the available land and are alike ill-nourished, both toiling wearily in a heartless effort to extract from the ill-nourished earth enough to keep them from starvation.[1]

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[1] A Communique of the Punjab Government, August, 1936. Milk in many parts of India becomes very deficient in Vitamin A during the dry season. The influence of fodder and agricultural practice on the nutritive quality of foods of animal origin is now gradually being realised in India. The nutrition of the live-stock has important bearings on the quality of milk and the amino-acids which enter into the composition of a diet.

RELIGIOUS SENTIMENT VERSUS PRACTICAL COMMON-SENSE

The numbers of cattle have become so large and their efficiency has fallen so low in India as results of the process having advanced so far that the task of reducing the number of useless animals and of reversing the process of deterioration is now extremely difficult. In several ways social and religious sentiments which belong to more spacious times in the past, and have now become obvious economic misfits, have conspired to aggravate the difficulty. To kill a bullock or a cow is a deadly sin in Hinduism. The orthodox Hindu often objects to sell, even in extreme circumstances, because sale is usually to a butcher and leads to the slaughterhouse. Rather than selling the cattle to the cattle-dealer he sends them to a gowshala or lets them loose to die. There is a remarkable difference in this respect as between Hindu and Muslim communities, with its reactions upon agriculture and animal husbandry. North of the Jhelum in the Punjab, Darling observes, cattle-breeding should be as easy as everywhere else it is difficult; for, except among the few Hindus, there is not the least prejudice against the sale to the butcher of infirm or aged stock, and it is even rare for a bullock or cow to be kept from affection after it is past work. Nor does anyone object either to castration or to inoculation on religious grounds. Further, north of the Jhelum bulls are nearly always tied up and to the south, according to Hindu custom, they are allowed to roam wherever they like. In the one case breeding can be controlled and in the other bulls wander about the fields consuming or damaging at least three times as much fodder as they need, and covering as they please. The difference is of great importance in a country where cows are of all sorts and good bulls far too few.[1] Unless the Hindu sentiment is abjured altogether the Indian cultivators cannot take a practical view of animal keeping and will continue to preserve animals many of which are quite useless from birth to death, the number of these being the greatest among the small cultivators who can afford it least. Secondly, the ancient right of dedicating a bull as an act of piety was once a public service, the animals in old times being carefully selected and of a good class. Now the animal dedicated is generally selected for its worthlessness and the sire has often become a vagrant pest. The open field system of the vast majority of the Indian villages makes it difficult to control the promiscuous mating of animals. Miserable, half-starved males roam about in the countryside, perpetuating their species and further reducing their quality in the country.

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[1] See also McCarrison's valuable note on nutrition appended to the Report of the Royal Commission on Agriculture.

THE DUAL PURPOSE CATTLE

An important remedy lies in the direction of evolving suitable types of dual purpose animals, the males being efficient as field workers and the females as milch animals. Such cattle are obtainable in India, many of the best breeds posing these dual qualities. Such dual breeds will include buffaloes, the high butter content of whose milk makes them specially valuable for *ghee* production and the basis of prosperity of mixed farming in the Punjab, Gujerat and the United Provinces. Buffaloes, however, can compete on the whole favourably with ordinary cows, as they are heavier milk-yielders, and possibly even with improved cows in areas where coarse forage is abundant. Another advantage for the peasant in buffalo keeping is that buffaloes can be more easily disposed of even for slaughter than the cattle. High-grade cows of Indian milch breeds are, however, already after only a comparatively few years of selective breeding, able to hold their own, under suitable conditions of management, in regard to the over-all cost of milk and butter-fat production.[1] The male cattle also is more useful as a draught-animal than the male buffalo in the greater part of India. Thus the evolution of the dual purpose cattle will render buffaloes largely superfluous as sources of milk and reduce their numbers in the country. The development of mechanical transport, which will enable milk to be brought rapidly to the cities from the distant villages where cows can be kept economically, may greatly aid dairy farming. Refrigerating apparatus and pasteurisation may also contribute towards the economical maintenance of milch cows and buffaloes in the country-side and towards the solution of the chronic scarcity of milk in all Indian towns.

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[1] Darling: *Wisdom and Waste in the Punjab Village.*, p. 73.

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[1] See *Review of Agricultural Operation of India*, 1919–1931, also Olver: "Live Stock Improvement in India," *Agricultural and Live-Stock in India*, July 1937. No doubt cows on the whole are more useful than buffaloes, first, because they produce better working animals, and, secondly, because the cow's milk is a much better food, particularly for children, than buffaloes' milk, watered down to the same level of butter fat. Thus it is desirable to breed, feed and maintain cows as she-buffaloes are maintained now in selected areas. Olver thinks that a definite segregation of working type and milch type cattle is essential for the improvement of livestock and stresses the inadequacy of dual-purpose as the goal in breeding. The majority of small holders in India, however, find it economically convenient to have one or two cows not of the specialized heavy milk-yielding type, but of the ordinary sort which can yield them good working type bullocks by mating with the specialized working type of bulls. The agriculturist takes to the sale of milk and milk products as a by-occupation and cannot also afford to feed and maintain the more specialized dairy type animal. These economic factors would seem to indicate the advantage of the dual purpose goal; while its disadvantage is minimised if the cultivator is taught to discard those animals which do not show the desired combination of traits.

OBSTACLES TO MIXED FARMING

With such facilities, a type of simple dairying on the basis of two or three better class milch cows in each holding and growing fodder crops, may increase the output and maintain the fertility of the land, provided that the number of both human and animal dependents on the farm does not overstep proper limits. A balanced combination of dairy and cereal farming may thus have the obvious advantages of providing for the proper nutrition of the cultivator's family, increasing the income from the land and at the same time minimising the risks of over-production of money-crops, and of soil depletion, both of which are difficult to avoid. Belgium, Netherlands and Germany provide excellent examples of countries which are densely populated and highly industrialised and in which cattle form a part of a system of intensive cultivation based on dairy farming. The proportion of dairy cows in the herds was as high as 52·7 in Belgium and 50·5 in the Netherlands in 1933. In Germany the large proportion of cows (56·8) in the herds is especially noteworthy and indicates the importance of the dairy industry. Milch cows predominate on the smaller holdings in Germany, where they are also frequently used for work, and as the size of the holding increases the relative number of dairy cows tends to diminish. In South Germany the custom of working the cows in the fields is common, but the practice does not obtain in the plains of the northern and eastern Provinces, where attention is concentrated on dairying and the production of beef. The existing grassland is insufficient to provide adequate feed for the stock and recourse is had to import of fodder, development in the supplies of hay, clover, lucerne and sweet lupine and to the utilisation of cattle cake consisting largely of the residual product of Germany's important oil-seed and nut-crushing industry. In India the indigenous manufacture of vegetable oils might also increase the production of concentrated feed, which could be an important factor in the rationalisation of dairy farming. Such a high proportion of milch cows in the total cattle population in Central Europe is ample evidence of the success of animal husbandry. Similar figures about dairy farming are not available in India. A local investigation in Burdwan (Thana Ausgram) shows the number and kinds of cattle as follows:

	Village Aligram	*Village Ausgram*
Draught bullocks	144	150
Useless cattle	4	2
Bulls	3	2
Milch cows	43	40
	194	194

The percentage of milch cows in the total bovine population are only 22 and 20. The yield of milk is only 1 maund, 1 seer. A similar investigation in Saugor Tahsil, Saugor District in the Central Provinces, shows the distribution of cattle as below:—

	Simaria	*Kerbana*	*Majguan*
Draught Bullocks	180	228	182
Useless Bullocks	5	11	7
„ Bulls	6	7	3
„ Milch cows	104	211	159
Total number of cattle including the young stock	537	922	775

Milch-cows yielding less than two seers of milk per diem are regarded as uneconomical. The preponderance of useless cows and bulls is evident from the above investigations. On the other hand, in those areas in India, where mixed farming is in vogue, only a moderate but efficient bovine population is maintained on the holdings, which grow more fodder crops and yield much larger quantities of milk and milk products for both consumption and sale. A recent survey of seven of the most typical breeding tracts of India has revealed that while in India as a whole Wright has estimated that only 7 to 8 ozs. of liquid milk per head per day are consumed, these areas show a *per Capita* consumption of milk and milk products of about 10 ozs. per day. A balance of 13 ozs. is mostly sold off the holdings as milk or *ghee* though a small proportion is stored as ghee for future use. In addition, the skimmed milk is also consumed, the average consumption per head being 8·75 ozs. per day. In the zones of heavy human population pressure, however, where the cultivator cannot obtain adequate subsistence for his family from the holding it is impossible to expect the development of mixed farming, based as it is on the production of fodder crops. Where neither suitable grazing is available nor fodder crops can be grown, the working bullocks can be kept in proper condition only by the practice of controlled breeding, and elimination of the unfit. It will be enough gain for the small cultivator if his bullocks can improve their draught power and their supply of humus to the soil. Even the cow ordinarily does not at present produce enough milk for her calf in these tracts, and the introduction of the milch type cattle, which requires more food, would be futile. Here and there, where the holdings are larger, the well-to-do cultivator may take advantage of the expansion of the market for milk and *ghee* by maintaining a few good type milk animals and growing fodder crops for them. But on the whole in the areas of human concentration in India where the majority of holdings are undersized, the slender resources of the farmer, and the necessity of devoting every section of his holding to food or to crops which yield him a direct cash return, prevent the adoption of systematic dairying.

PLANNED PROGRAMME FOR OVERCOMING THE CATTLE CRISIS

In a country of dense population, as India is, the combination of dairy industry with farming can only be attempted in tracts where there are large, actual, or potential grazing areas. For the rest of India, the adoption of dairy farming, the expansion of fodder crops, stall feeding, and the improvement of breed, all hang together, and these ultimately rest on a planned programme of reduction of superfluous and useless cattle. Definitely the first step towards mitigating the present cattle crisis should be the compulsory castration of all unfit and useless male stock and legislative restriction, wherever practicable, of the number of calves in each herd. Not only scrub bulls but also uncastrated bullocks used for carts should be castrated to prevent damage to the breed. Greater increase of the inferior cattle aggravates the fodder situation and makes dairying impossible. That a notable victory has been won over popular prejudice is shown by the fact that in the Punjab alone in 1932–1933, 482,000 animals were castrated. Ringing of the bad cows so as to make covering impossible should also be introduced and popularised. This is done in the south-west of the Punjab. The Netherlands Government has recently embarked upon a policy of restricting cattle numbers and to this end a Cattle Crisis Act was passed in 1933. It was planned to reduce the number of cows by 200,000 by the end of 1934. The Agricultural Bureau under the jurisdiction of the State, purchases and slaughters cows, and the beef is used for export or canned for special sale to the unemployed. The State has provided a grant, which is augmented by a slaughter tax on all cattle slaughtered for home consumption. At the same time production is controlled by specifying the number of calves to be retained in the herds.[1]

India must adopt a definite programme of reduction of cattle numbers and of controlled breeding. With decreased but more efficient cattle, the expansion and improvement of fodder cropping and pasturage, introduction of silos, stall feeding and controlled grazing in favour of superior stocks will be easier. Outside the zones of human concentration the development of dairy farming in association with intensive agriculture will supply milk, butter or

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[1] *Cattle and Beef Survey, Report of the Imperial Economic Committee,* 1934.

ghee to the dietary, add to the cultivator's income and prompt him to look after the female animals better. The improvement of fodder will react favourably on agricultural practice by increasing the productivity of land, without which the introduction of new varieties of crops can do little more. In India the tendency to view the improvement of crop production as involving two separate problems according as the crops are intended as food for man or for beast is apt to be exaggerated. There is a vital link between animal husbandry and crop production, and much improvement of Indian agriculture may accrue from the peasant devoting himself more to fodder crops and peas and beans which, or the production of which, may be used for food-stuffs, animal feed and fertiliser, and pay less attention to other kinds that are nearer the stage of over-production. Above all, it will relieve agricultural idleness, and lead to a better distribution of human and cattle power in the fields. In large parts of India, from the Punjab, Sind and Rajputana in the north, to Mysore and parts of Madras in the south, there are no doubt extensive grazing grounds where excellent work-cattle are produced under the ranch system at small cost. The production of these would be concentrated upon both for local use and for export as long as the best grazing areas are not taken up for more intensive cultivation, which will inevitably lead to the deterioration of the size and quality of the stock. But in the rest of India population pressure will on the whole exclude the development of an intensive system of mixed farming combined with dairying. Redistribution of the animal population among the thinly populated Provinces, and migration to the Western or Eastern

Indies and other tropical regions where the Indian cattle show themselves to be hardier and more immune to tick-borne diseases than the local breeds, are some remedies. But the real remedy lies in a practical view of animal keeping and working on the part of the Indian peasant. China and Japan do not raise animals because they seek to economise the land and human food resources as far as possible. In India the reverence for the mother cow defeats itself because it is responsible for raising millions of half-starved worthless beasts, which have now become a serious burden on her small holdings. Such multiplication not only leads to the waste of her scanty grass-land resources and makes it more and more difficult for the upkeep and breeding of superior live-stock, but it also contributes to soil deterioration and deprivation of the masses of dairy products in their vegetable dietary, which is poorer and less varied than in China or Japan. The excessive burden of uneconomical stock in India, indeed, aggravates human poverty and malnutrition, as men and beasts are engaged in a cruel and vain triangular struggle to wrest from the ill-nourished, over-burdened soil more and more crops, fodder and grasses to keep them from starvation. India, with her human burden of 377 millions, and her 48 millions of "average men" estimated without food, can ill afford to add indefinitely to her enormous bovine population of 214 millions at the rate of 20 per cent per decade and permit the cult of *ahimsa* to get the better of the improvement of human food resources.

CHAPTER XI

INCIDENCE OF MALNUTRITION

OPTIMUM AND UNDER-NUTRITION

The question of finding out an optimum nutrition for the people of India is cognate to, and as important as, that of finding out an optimum density for the Indian population. Deficiency diseases are on the whole not widespread in India, at least in years of normal rainfall and abundant harvests, but the mere absence of typical deficiency diseases is not enough. Every civilised government must aim at optimum health and efficiency of the people. In India the study of the incidence of malnutrition has not even begun, although the most considerable section of the population may be regarded as living on a subnutritional level, which gravely affects their powers of resistance and efficiency.

That typical deficiency diseases become prevalent in regions affected by scarcity, has been abundantly shown by a survey undertaken by the author in several scarcity areas in Western Bengal in the summer of 1935. A food survey was also taken up which indicated that a considerable section of the population depended upon rice refuse and polishings, edible or inedible leafy vegetables, containing largely cellulose and water.

FOOD VALUES OF DROUGHT DIETS

India's drought and famine foods need careful physiological scrutiny. These show a unique adaptability to unfavourable conditions of food supply brought about through centuries of trial and error in food selection. Examination of men, women and children in famine camps and relief works should be made also with the object of establishing standard famine diets. Side by side the incidence of food-deficiency diseases should be carefully investigated.

An analysis of the food values of diets, carefully collected by me in Western Bengal among labourers in Test works at Chhatra and Sonamukhi in the district of Bankura, and Budbud and Ausgram in the district of Burdwan, has shown serious underfeeding. Sample diets have been taken not only from among the labourers in the Test works but also from among the peasants in villages in their hinterland who are engaged elsewhere.

Aswatha, tamarind and other fresh or dried leaves, fruits of *babla*, *aswatha* and *bat*, kuro of rice and refuse of jack fruit and scales of fish have been found among the materials consumed in conditions of need.

FAMINE DIETS IN BANKURA AND BURDWAN, JUNE, 1936

		Food value of the Food Ingested			*Total Caloric Value*	*Number of Calories that are taken Normally*	*Percentage of Deficiency*[1]
Bankura	*Amount of Food Taken*	*Proteins in Grams*	*Carbo-hydrate in Grams*	*Fat in Grams*			
FAMILY I							
3 adults (2 males and 1 female), 4 children aged 10, 8, 5 and 2 respectively.	(i) Rice with gruel, 3 seers (ii) ½ seer *Natia Saka*	210	2,322	27	10,371	11,070	6·3
FAMILY II							
1 adult (male)	(i) 1⅓ pau rice with gruel. (ii) ½ pau *Natia Saka*	23·3	257·9	2·99	1,151	2,400	52·0
FAMILY III							
1 adult	Rice with gruel 4½ ch.	19·6	217·3	2·5	969	1,749	50·3

[1] 2,400 calories per adult doing moderately heavy work are taken as the nutritional standard.

FAMINE DIETS IN BANKURA AND BURDWAN, JUNE, 1936—*Cont*

Burdwan	*Amount of Food Taken*	*Food Value of the Food Ingested*			*Total Caloric Value*	*Number of Calories that are taken Normally*	*Percent Variat*
		Proteins in Grams	*Carbo-hydrate in Grams*	*Fat in Grams*			
FAMILY I Middle class, "suri" by caste One adult female and one female child aged 10	Rice with gruel, 1 seer and ½ pau with *Saka*, leafy vegetable (which consists almost entirely of cellulose)	79	870·7	10	3,876	3,447	+12·
FAMILY II One adult female, 3 boys aged 3. 7 and 10	(i) Rice with gruel, 1 seer and ½ pau (ii) *Khero* and *kalmi saka* ½ pau	79	870·7	10	3,876	5,814	−33·
FAMILY III One adult male	(i) Rice with gruel, 2 pau (ii) Potato and gourd, ½ *chatak*	35	387	4·5	1,728	2,400	−32·1
FAMILY IV 3 adults (1 male and 2 females), and 2 children, aged 5 and 10	Rice with gruel, 2 seers	140	1,548	18	6,914	8,404	−12·

DEFICIENCY DISEASES

Ulceration of the tongue and raw surface in the lips and corners of the mouth and eyes have been found ordinarily among the hospital cases in Bankura. Cases of extreme emaciation were, however, not to be found in the works because of the toil involved, which shut out the debilitated, but enquiries indicated that not a small percentage of the workers earned below the maximum 2 As. wages because of the strain. Extreme fatigue was indicated by their repeated disengagement at intervals.

A dozen nutritional œdema cases were discovered in Thana Ausgram from village Kelity; these persons came for receiving doles in Guskara relief centre in Burdwan.

Where the people have been eating between one-third and one-half of their normal food, deficiency diseases, such as painless diarrhœa, dropsy, ulceration and general waste and loss of muscles and weight and retardation of puberty in females, may be found prevalent here and there; and a group of medical men from Calcutta with an itinerary in the famine-stricken areas may collect valuable data in this connection.

A serious menace in the district of Bankura is the spread of leprosy, which has increased at least two-fold during the last twenty years. It has been estimated that there are now about 45,000 lepers in the district and that in some parts about three-fourths of the villagers are affected. Leprosy may have something to do with soil exhaustion and depletion of certain mineral elements or other food values in cereals. It is probable that the fight against leprosy, in order that it may succeed, has to be carried out both on economic as well as hygienic fronts, and that along with careful treatment and segregation, very difficult to secure among the aboriginals and semi-Hinduised lower castes, a programme of enriching the soil with adequate organic and chemical manures will prove helpful in combating this fell disease, now spreading like wildfire in the habitations of Bankura and Birbhum.

INELASTICITY OF INDIAN FOOD HABITS

The masses of India are not only on a sub-nutritional level but also suffer from the inelasticity of dietaries due to religious prejudice, social custom and inertia. Economic and religious considerations blend together and determine whether fish, flesh, milk and eggs, which contain a high percentage of protein of good quality, will enter into the dietary or not. Many deficiency diseases, as, for instance, dysentery and diabetes, arise among a population of rice-eaters, due to an inadequate intake of proteins; thus faulty and unbalanced diets are as much responsible for disease and mortality in India as deficient or inadequate diets. The cityward drift has caused changes in the dietetic habits of the people, reducing the amount of various protective foods in their dietaries and making them more susceptible to infections. In the cities and towns animal fats such as butter, cream and *ghee*, which are much superior to vegetable fats and oils, are beyond the reach of the majority of the population. Fish, meat, beef, and eggs, which are all dearer in the cities, are given up by castes and communities, habituated to these, when they migrate from the villages. Workers who have migrated from Eastern Bengal, where fish is cheapest and most abundant in India, cannot obtain these in adequate quantities; while milk and milk products as well as fruits are too dear in Calcutta city. Among the Bombay working class the Konkanis, who come from the coastal district, and are accustomed to eating fish in their villages, similarly have often to discard it in Bombay city where it is a costly diet and its dietary value is not at all commensurate with the money spent.[1] In all Indian towns the percentage of the total food eaten by urban dwellers derived from cereals is too high, and the animal and total protein, and the milk products, much below what is recommended by Western standards. A recent survey, undertaken by Professor H. Wilson, of three children's institutions of Calcutta, a Mohammedan, a Hindu and an Anglo-Indian respectively, showed that the diets were poor in total animal protein, animal fat, and, above all, in calcium. The consumption of milk and milk products was either nil or negligible in relation to the total food consumed. The institutions appear to show the best return for money spent, in spite of the fact that, qualitatively, the diets fell below those of the families. Dietetic experiments with skimmed milk among South Indian children have indicated that stomatitis, a common deficiency disease, disappears when skim milk is fed. School girls (ages 5 to 17 years) studied by Wilson in Lahore showed 40 per cent incidence of rickets. Convulsions, malnutrition and septic skin conditions account for a considerable proportion of infantile deaths throughout India.

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[1] *Royal Commission on Labour in India*, Evidence Volume (1), Part I, p. 434.

Adulteration and artificial substitution also deprive many foods of much of their real food value in India. These evils are more serious and widespread in this country than in the West, and in the cities than in the villages. Further, as industrialisation develops, the food grains are less frequently brought to the homes and ground in hand-mills in the towns. The milling and polishing both of wheat and rice deprive them of important food materials.

INAPPROPRIATE FOOD PREPARATION

Inappropriate food preparation thus leads to a good deal of waste. Rice, for instance, is deficient in Vitamin A, and this deficiency may be extreme if the rice is used parboiled, the process of parboiling and subsequent drying in the sun depriving the rice grains of such small amounts of this essential as they originally contained. It may or may not be deficient in Vitamin B, according as the rice used is milled and polished, home-pounded, or parboiled. If the first, it does not contain enough Vitamin B for its own metabolism, nor does that provided by the legumes used with it suffice to make good the deficiency. It is in such circumstances that beri-beri is prone to arise.[1] It may be mentioned that beri-beri is a cause of widespread sickness in Japan and accounts for a considerable number of deaths. Penrose estimates that probably over 50 per cent of Japanese students suffer from beri-beri at some time in their school and college careers. Different varieties of rice, unpolished as well as polished, differ in degrees of digestibility of starch. It has been found that the rate of enzymic hydrolysis increases with increased polishing until, with a very high degree of polishing, there is no change in digestibility. The viscosity of the cooked rice flour, however, increases with polishing. The difference in digestibility of unpolished and polished rice is greater in red rice and in coarser varieties in general than in white or fine rices.

The red portions of the ordinary rice are now usually discarded by all classes. We read in the *Bihar and Orissa Census Report:* "Except the sweepers, Haris, Sahars, etc., almost all classes have recourse to polished rice, which has resulted in serious losses of vitamin, as a result of which beri-beri is noticed in places"; while in Bengal, although the new comers among the immigrant labourers still adhere to cheap red rice generally, those who are living long in Bengal prefer white milled rice.[1] Similarly, white wheaten flour (maida) consumed by the middle classes in Bengal is as deficient in Vitamin B as polished rice, and researches show that animals fed on maida develop polyneuritis. It is necessary to find out the best method of husking paddy without polishing and removing the outer covering of the grain. The All-India Village Industries Association have found, after a survey of various methods of pounding rice in different parts of the country, that *Dheki* husking and husking by pestle and mortar polishes the rice to some extent while husking on earth, stone, cement and wooden *chakkis* gives better results. Since the consumption of food other than rice is exceedingly small among the poorer classes, the nutritive value of rice, influenced as it is by the degree of milling, becomes of great significance. Recently the Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene have drawn attention to the possibility of checking the spread of mechanical rice mills in rural areas, with a view to conserving the healthy habit of consuming home-pounded rice and to means of making under-milled rice easily available to those who wish to purchase it.

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[1] McCarrison: "The relationship of diet to the physical efficiency of Indian races," *Practitioner*, Vol. CXIV, p. 98.

DEFICIENCY OF VITAMINS

The spread of epidemic beri-beri in Bengal has recently focused the attention of the layman on to the need of consuming under-milled rice and wheat which contain Vitamin B that counteracts beri-beri. There are some diseases, such as diarrhœa, dysentery, beri-beri, malnutritional œdema, epidemic dropsy and xerophthalmia which are found especially in Bengal and Madras and are caused by faulty unbalanced diets. Bengali children who are fed on polished rice and are provided with other foods in small quantities show a high incidence of rickets. Wilson's measurements of the A.C.H. (arm-chest-hip) index of nutrition indicate that children in an orphanage in Calcutta, from which foods were investigated, are 50 per cent, while those in a better class school are 12 per cent, below par. In large areas of Southern India, where milled rice is the staple article of diet, nearly all the pregnant females are in a state of avitaminosis B^1. As a result the incidence of premature births is three times as great as it is in the north of India (where wheat is the staple diet), and in consequence the infant mortality rate also is many times greater.[1] The shortage of Ca and P is often as serious a factor as Vitamin D deficiency in the causation of rickets and osteomalacia in India. Tuberculosis is estimated to be twice as prevalent in South India as in the Punjab. Ulcer of the stomach, rickets and anæmia are much more common in South India and Bengal than in Northern and North-west India. Aykroyd has found symptoms of Vitamin A deficiency quite common among children in Southern India, and suggests that Vitamin A deficiency may be a causative factor in the production of stone, which is widely prevalent both in Bengal and Madras. He observes:

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[1] A. C. Roy Choudhry: *Report on an Enquiry into the Standard of living of Jute Mill Workers in Bengal*, p. 16.

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[1] Balfour and Talpade quoted by Leslie Harris. See his "Vitamins" in Annual Reviews of *Bio-Chemistry*, 1932–35 and *The Incidence and Assessment of Malnutrition.*

"While pellagra is uncommon in India a large percentage of children in South India show a pellagra-like stomatitis, which is curable by foods rich in P-P factor. Xerophthalmia of varying degrees of severity is commonly met with, and keratomalacia is one of the most blinding diseases in South India. Follicular keratosis of the skin, due to diet deficiency, is of extremely common occurrence." The high incidence of dysentery in the jails of Bengal as compared with the low incidence in those of the Punjab is also full of significance. Infantile mortality is now being recognised as largely due to deficiency of vitamins, with its resulting gastro-intestinal and pulmonary disorders; and it is greater in Madras and Bengal than in the Punjab. The much higher incidence of leprosy in the south, west and east of India has also probably a nutritional basis. The increase of leprosy in the rice tracts of Northern Orissa, South-western Bengal, Deccan and Madras is perhaps connected with exhaustion of soil and deficiency of food values of rice grains.[1]

Another significant instance of inappropriate food preparation is afforded by the use of boiled *ghee.* Vitamin A has been found fairly stable at temperatures up to 125°C., but is rapidly destroyed at higher temperatures. Throughout India *ghee* is subjected to high temperatures and thus Vitamin A is completely lost. The loss of the yellow colour of *ghee* runs parallel with the loss of Vitamin A and it takes a longer time for the buffalo *ghee* to lose its yellow colour.

The experiments of Papanicolaou and Stockard, the observation of Frederick von Mueller in the period of under-nutrition in Germany, and the researches of Professor H. Stieve indicate very strongly that underfeeding alters fertility and has profound effects upon the organs of generation; and also that it causes a retardation of development, especially of young animals and children, as well as symptoms of disease in fully developed adults. The everyday clinical experiments in rickets, scurvy, etc., show how important vitamins are to the growing child and even to the adult. Fertility, resistance to disease, height, weight, general endurance, learning capacity, and many of the qualities of personality are strongly influenced by diet in the sense that proper environment in relationship to the matters of diet and hygiene promotes the development of superior individuals, if we regard greater height, greater weight, resistance to infection, and better learning ability as evidence of superiority.[1]

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[1] Mukerjee: *Rural Economy in India*, p. 122.

CHARACTERISTIC DEFICIENCIES OF BENGAL AND SOUTH INDIAN DIETS

Our table in Chapter V (page 78), showing the distribution of protein, fat and carbohydrate in dietaries in different parts in India, indicates that the least satisfactory of all the Indian diets is that consisting of rice, *dal*, vegetables and condiments; this diet is used by millions of people in Bengal, Orissa, Madras and elsewhere. Such diet is associated with the lowest grade of physical efficiency and health in India, and McCarrison notes its following defects: "Poverty of protein, excess of starch, deficiency of certain mineral elements, deficiency in Vitamin A, deficiency in Vitamin B." Wright's investigations have shown that destruction of eyes as a result of Vitamin A deficiency is the commonest cause of blindness in the Madras Presidency. Systematic investigations will probably reveal eye and skin symptoms due to Vitamin A deficiency in almost any municipal or village school in Southern India. It is also probable, according to Aykroyd, that such diets also tend to be deficient in calcium, and deficiency in calcium affects adversely the functioning of every tissue in the body. The foods richest in calcium are milk, cheese, green vegetables, and unmilled cereals. In striking contrast with the diet in Bengal and Madras, which predisposes the people to an unusual susceptibility to infection, a proneness to dysentery and diarrhœa and a marked tendency to deficiency diseases like epidemic dropsy and beri-beri, we have the rich and nutritive diet of the Punjab and North-Western Frontier Province, with or without animal proteins but with its abundant supply of milk and milk products, fruits, and vegetables added to the basal whole meal bread, tubers and roots. We have already noted the abundant supply of calories (4,000) yielded by the *menu* consumed by the Jat cultivators in Lyallpur. In the United Provinces the diet of the western districts approximate to that of the Punjab. But in the eastern districts of the United Provinces and Bihar, which grow more rice than wheat, the diet becomes less nutritive and less balanced; yet in these areas wheat, flour, and *ghee* still retain their importance, and the protein element in the diet is greater than in Bengal. The level of nitrogenous metabolism is at least 20 per cent higher in the North Indian peasant than in the peasant in Bengal; and his average weight also is greater, 120 lbs. as compared with 110 lbs. of the cultivators in Bengal and Madras.[1]

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[1] Myerson: *The Inheritance of Mental Diseases, and Social Psychology*, pp. 68, 90–91.

The improvement of means of communications and transport and facilities of marketing have now overcome the natural handicaps of different parts of India in growing more nutritive cereals and pulses which form the staple foods of regions under more favourable conditions of soil and climate. Thus ignorance and conservatism have to be overcome in order that the average Bengalee and Madrassi, for instance, may consume wheat, ragi, and *dal* which have built up the larger, stronger and hardier body of the Punjabi. Rice-eating peoples preferring a mixed diet of wheat, barley and millets, which may be obtained at reasonable prices from other Provinces in combination with rice, will enormously improve their standards of nutrition and efficiency. Unpolished rice may be used in the form of *roti* of the flour and a mixture be formed with other grains or pulses. At present wheat and ragi are cheaper than rice both in Bengal and Madras.

ADAPTATION OF CLIMATE, DIET AND RACE

The following table gives the comparative figures of the weight of prisoners and labourers in the different Provinces:—

Province	*Average Weight of Prisoners*	*Average Weight of Labourers*
Burma	125·70 lbs.	117·14 lbs.
United Provinces	115·08 ,,	107·01 ,,
Punjab	115·05 ,,	113·08 ,,
Bengal	115·05 ,,	107·93 ,,
Madras	114·38 ,,	113·63 ,,
Bombay	112·12 ,,	102·9 ,,
Eastern Bengal and Assam	110·84 ,,	108·0 ,,
Central Provinces and Berar	110·45 ,,	100·92 ,,

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[1] Leitch: *Dietetics in Warm Climates*, p. 134.

Lt.-Col. D. McCay wrote 30 years ago: "As we pass from the north-west regions of the Punjab down the Gangetic plain to the coast of Bengal, there is a gradual fall in stature, body-weight, stamina and efficiency of the people. In accordance with this decline in manly characteristics it is of the utmost significance that there is an accompanying gradual fall in the nutritive value of the dietaries, and more especially in the average level of protein metabolism attained by the people of the Punjab, United Provinces, Bihar and Bengal."

McCarrison supports the above nutritional generalisation. He makes a study of the races of India and their diets, and, after discussing the distribution of food products in the different zones of India, observes that "nothing could be more striking than the contrast between the manly, stalwart and resolute races of the north—the Pathans, Baluchis, Sikhs, Punjabis, Rajputs and Maharattas—and the poorly developed, toneless and supine peoples of the east and south: Bengalis, Madrassis, Kanarese and Travancorians."

Following this study he took groups of young rats—20 in each group—which were fed on certain national diets of India, care being taken in every detail to stimulate the particular culinary practices (fortunately, rats like the same food as human beings). The animals were obtained from the same stock, an unusually healthy one. The experiment was so conducted that factors such as climate, atmospheric temperature, rainfall, age, body-weight, sex distribution, caging, housing, and hygiene were the same in all groups; and it was found that the nutritive values of these diets, as determined by the average body-weight of each group at the conclusion of the experiment, ranged themselves in the following order:—

Diet	*Average Body-weight of Group*
Sikh	235 grams
Pathan	230 ,,
Mahratta	225 ,,
Kanarese	185 ,,
Bengali	180 ,,
Madrassi	155 ,,

Further evidence of the health-giving properties of the Sikh diet is afforded by complete absence of any evidence of disease of the stock rats fed on this diet except an occasional cyst (tapeworm) in the liver.

Both McCay and McCarrison seem, however, to exaggerate the importance of the dietetic factor. Everywhere there is a reciprocal adaptation of climate, diet and stock. The lower metabolism of a Bengalee or South Indian accounts for the lower protein content of their diet, humidity being a highly important governing factor of basal metabolism. Nor can we say that the Punjabi's diet is adequate in quantity and quality. The Punjab enjoys during about half the year a remarkably stimulating climate. "It is possible," shrewdly observes Lt.-Col. C. A. Gill, "that the Punjabi is what he is not because of, but in spite of, his diet." An examination of the dietary of casual labourers employed in industrial enterprises in the Punjab yields a value of 2·347 calories only, which is the lowest reached in the table we have given. As one passes from the north to the west, east and south, rice begins gradually to replace wheat and so long as milk and milk-products are consumed in sufficient amounts, or adequate animal proteins and fats from other sources are ingested together with fresh vegetable foods, there is no dietetic reason for physical deterioration. McCollum, one of the greatest authorities on nutrition, points out that in the warmest regions of the world, which are also characterised by excess of wetness, one of the most successful human dietaries have evolved. Such dietary consists of rice as the principal cereal, with additions of beans, pulses, various tubers and root vegetables and large amounts of leafy vegetables of all kinds. The leaf of the plant is superior to the seed, tuber, root or fruit in its dietetic property. In fact the edible leaf, which is in itself complete from the standpoint of its dietetic principles, is widely used, especially in Bengal and Southern India. In these areas such leaves as *Methi*, *Bathu*, *Palong* and *Pooin* and those of gram and turnip are used in the manner of spinach, and turnips, carrots and onions are generally eaten raw. A number of fruits such as mangoes, jack-fruits, guavas, plantains and lemons, eaten raw in the moist regions of India, contain vitamins in not inconsiderable quantities. Tamarind pulp and *amchur* or mango and lemon pickles are most important sources of vitamins consumed everywhere. Some of the recent findings of Rudra are given below:—

VITAMIN C CONTENTS IN MG. PER G.

Food-stuff	*Skin*	*Flesh*	*Seeds*	*Leaves*
Patal (***Mimordica diorca***)	0·44	0·25	0·1	0·29
Ninna (***Luffa ægyptica***)	0·20	0·04		
Kumra (***Cucurbita maxima***)	0·098	0·05	0·036	0·11
Plantain (***Musa***)	0·092	0·099		
Banana (***Musa sapientum***)	0·062	0·052		
Pear (***Pyrus communis***)	0·072	0·016		

Animal foods have given the following results:—

Goat's flesh, 0·066; liver, 0·26; kidney, 0·176; heart, 0·077; bone-marrow, 0·0888.

The juice of Tulsi leaves, green chillies, cabbage, bitter gourd, cauliflower and small radishes, containing a fairly large amount of Vitamin C, form common items of diet. In the wetter regions of India the masses consume habitually a variety of fruits, vegetables and leaves from season to season. The smaller weight, stature and physical capacity of the Bengalee or Madrassi, as compared with the Northerner, are governed by the *ensemble* of racial and environmental factors (especially temperature and humidity) of which a low protein dietary is only one. It is, however, going too far to condemn the Bengalee and the Madrassi for their inadequate and unbalanced diet and attribute only to this their inferior physique and lower efficiency. The physical characteristics of peoples and the nature of their diets are matters of environmental adjustment and neither the Bengalee nor the Madrassi, with his lower nitrogenous exchange, has proved a less successful farmer or less virile in the damp, moist climate. As between the Bengalees and South Indians it has been found on the basis of comparison of physical characteristics of children that the former are about 7 per cent superior in both height and weight, and that the Calcutta school-boys, even of the poor class, shew a more regular gain in stature each year than the Coonoor, Calicut, Mettupalayam and Trivandrum boys studied.[1] Whether this is due to climate, race or diet is not ascertained.

WHEAT VERSUS RICE IN THE UNITED AND CENTRAL PROVINCES

But the most striking effects of diet and climate on the physical characteristics and working efficiency of people are to be found in the United Provinces and Central Provinces, where the contrasts between climate and between wheat and legume and rice and legume diets are vivid within the same Province. The wheat- and legume- eaters of the Meerut Division have, as a rule, much better physique than the rice- and legume-eaters of the Gorakhpur Division, even as the rice-eaters of Chattisgarh show the poorest physique among the people of the Central Provinces. Among the immigrant workers in Bengal the Madrassis are wholly rice-eaters. Wheat forms only one-tenth of the quantity of the rice consumed amongst the Bengalee workers. Rice forms two-thirds and wheat one-third of the staple foods of the workers of the United Provinces and Bihar in the jute mill areas in Bengal. The following table shows the contrasts in the staple foods of native and immigrant labourers in Bengal:—

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[1] Aykroyd and Rajgopal, *Indian Journal of Medical Research*, 1936 and 1937, and Macfarlane, *Current Science*, October 1937.

	Rice		*Wheat*		*Pulses*		*Total Calories for all Articles of Diet*
	Quantity	*Calories*	*Quantity*	*Calories*	*Quantity*	*Calories*	
Bengali Worker	9·9 Ch.	2,079	1·2 Ch.	238	1·2 Ch.	235	3,048
C.P. Worker	12·7 ,,	2,667	2·3 ,,	455	2·6 ,,	510	3,928
Madrassi Worker	10·3 ,,	2,163	·22 ,,	44	1·2 ,,	235	2,737
U.P. Worker	7·1 ,,	1,491	4·0 ,,	792	2·0 ,,	392	3,038
Bihari Worker	5·1 ,,	1,071	3·7 ,,	733	1·5 ,,	294	2,450

Ch = Chhataks

It will be noticed that the diet of the United Provinces immigrant worker in Bengal is not superior in calorific values to that of the native Bengalee worker who takes a more varied diet, spending more on other articles of diet than on staple food. The Central Provinces immigrant worker shows the least varied diet, and his consumption of a much larger quantity of rice than what the Bengalee or the Madrassi eats is chiefly responsible for the largest amount of calories per unit per yielded by his dietary (3,928 calories).[1]

Both in the Central Provinces, which is a meeting ground of different foods of India, and in Bengal, which invites a large number of immigrant labourers, the contrasts in the diet and physique of the workers is the most striking in India.

Coal Mines	*Weight*
U.P. worker	150 lbs.
Telugu	140 „
Seasonal Factory	
Raipur	125 „
Pandhurna	118 „
Nagpur	102 „

The average weight of Indian workers is 20 to 30 per cent lower than the standard weight of 154 lbs.

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[1] A. C. Roy Choudhary: *Report on an Enquiry into the Standard of Living of Jute Mill Workers in Bengal.*

CHAPTER XII

INEFFICIENCY AND POVERTY

Comparison of Output of Mining and Textile Labour in India and Europe

A comparison of the output of coal-mining labour in Europe and Bengal presents us with the most significant results of the effects of low dietary and small body weight and endurance.

The average protein intake of a Bengalee is from 50 to 70 per cent less than that of an average European. His average body weight is 25 per cent less than that of the European. His height is 5ft. 4in. and his chest measurement is 33in., while that of the European is distinctly higher. The minimum chest measurement for ordinary line regiments of the British army is 33in. while special regiments require much above this. The total gain in weight of a Bengalee between the ages 11 and 16 is only 29·7 kg. as compared with 39.3 kg. for a German and 32 kg. for a Japanese.

The following figures indicate the average mining output per individual worker over a number of years:—

America	589	tons (simple mining)
England	300	,,
Germany	243	,,
Bengal	80	,,

The Kankinanarah Labour Union of Bengal has deduced the following figures of comparison of Scotch and Bengali weavers in the spinning industry.

A twill weaver easily produces a little over 18 cuts of 100 yards each of 27 in. width in 5½ days of 60 hours and earns Rs. 10/6/6 a week, including a bonus of Rs. 3/12/–. It is reported that 10 years back a twill weaver could not take more than 15 cuts of this quality in the same period. A weaver of nine proters 40 in. Hessian takes a little over 14½ cuts in 60 hours and earns Rs. 9/14/9 including a bonus of Rs. 2/6/–. It is, however, doubtful if there has been any marked improvement in the efficiency of time-workers, e.g., of a spinner who receives about Rs. 5/12/– per week of 5½ days and minds, say, 25 spindles, whereas a woman in Germany and the U.S.A. looks after 150 spindles comfortably in that time. A Dundee weaver's average wages are about £2 15*s.* per week and he minds three looms—an Indian weaver minds only one loom—and his average wage is about Rs. 9/–.

Assuming the hours of work to be the same, say 54 hours, and the quality and size of the fabrics to be the same, the weaving cost of a ton in Dundee is about Rs. 26/8/– and in Bengal about Rs. 20/–.

It is true that these differences in industrial efficiency of British and Indian workmen are in large measure due to defects in machinery, equipment and organisation. But that climate, diet and physical capacity of the peoples also explain lower industrial output in India cannot be gainsaid.

SICKNESS, ABSENTEEISM AND MORTALITY AMONG INDIAN WORKERS

In India it is found that there are great seasonal variations in the basal metabolic rate. The sickness curve and the basal metabolic rate curve closely correspond to each other in Northern India. Such correspondence may be explained by the fact that the same factors which determine basal metabolism are favourable to the multiplication of man's bacterial enemies. On the other hand the lower basal metabolic rate in certain seasons favours infection. In Northern India, July, August, and September are the months when the basal metabolic rate is low and there is the largest amount of sickness. The following table gives the statistics of absenteeism due to sickness in 45 Jute mills in Bengal:

Month	*Number of Days Worked*		*Employed at the Beginning of Period*	*Persons Granted Sick Leave*	*Average Number of Working Days Lost per Person*
	Total	*Average*			
May, 1929	740	20·5	1,84,090	6,638	7·5
June, 1929	605	18·5	1,83,474	6,650	7·5
July, 1929	857	23·8	1,85,018	6,666	8·3
August, 1929	571	15·9	1,84,502	5,132	8·3
September, 1929	692	19·3	1,82,273	5,646	7·9
October, 1929	749	20·8	1,82,898	5,553	8·1

Malaria, hookworm and tuberculosis are the three diseases which are the most potent causes of industrial inefficiency in India. In the Province of Bengal alone, malaria levies a toll of from 250,000 to 350,000 per annum and contributes towards absenteeism, lateness and low output. In the Madras Presidency as much as 100 per cent of the rural population was found infected with hookworm a few years ago. Tuberculosis also levies an increasing toll in the slums of the industrial cities of India where the spread of infection is so easy.

The Indian peasant has developed a considerable immunity from certain parasitic infections but when he immigrates to the city, he becomes a special victim to several diseases. Major Norman-White observes in this connection: "Living an outdoor life, engaged in agricultural pursuits, the raiyat is able to put up with the considerable degree of parasitic infestation so commonly seen; malaria and hookworm infection, for example, is not incompatible with a fair output of agricultural work in such circumstances. Transference to large industrial centres, however, involves a change of environment which, apart from other considerations, connotes increased liability to disease. A more confined atmosphere, crowded insanitary dwellings, lack of out-door recreation are certain to exercise a baneful influence and render the factory employee more liable to fresh infections and to upset the compromise that his body has been able to effect with the parasites that it harbours."

Statistics relating to sickness and mortality among industrial workmen are not available. The following data have been collected for certain parts of the manufacturing city of Cawnpore, where factory operatives and their families form a large proportion of the population and show (*a*) the approximate percentage of factory population in the city, and in a few of the labour quarters, and (*b*) average mortality in each of them for the period 1921 to 1928:

	City as a whole	*Gwaltoli*	*Khalasi Lines*	*Raipurwa*	*Colonelganj*	*British India Corporations Settlements*
(*a*)	40%	60%	90%	70%	50%	90 to 95%
(*b*)	46·32%	75·29%	65·96%	54·43%	46·44%	34·58%

The significance of the above figures will be better appreciated in the light of the following table of average mortality for the last five years for various areas:

Province as a whole	*Rural areas*	*Urban areas*	*Municipal areas*	*Cawnpore*
24·83%	23·94%	37·13%	38·51%	46·32%

Tuberculosis is a scourge among industrial workers, especially females of Cawnpore. The average mortality from tuberculosis for the years 1925–1928 in the city is 4·67. The figures of mortality from other respiratory diseases were 1·8 and 3·4 respectively. In the quarters largely inhabited by the factory population of Cawnpore the death-rate due to tuberculosis among females is known to have risen as high 8·8 per mille.[1]

URBAN AND RURAL HOUSING

That tuberculosis and respiratory diseases, as well as epidemics like plague, cholera and small-pox, levy a heavy toll of human lives is the result of an appalling congestion in all industrial cities in India. Seventy-four per cent of Bombay's population and 90 per cent of the industrial workers, close on 800,000 persons, live in one-roomed tenements and the average number of persons per room is 4·01. In Cawnpore 62·5 per cent and in Nagpur 60 per cent of the population live in a single room. Small mud huts, with one room at the back and one room or verandah in front, is the usual type of accommodation available for the working classes in most industrial centres in India. The size and height vary, being usually 8ft. by 6ft. by 6ft. The only outlet for light and ventilation is the main door. Such quarters are often sub-divided between two, three or four families and as many as 10 persons may be found in one of these huts. In Lucknow no less than 670 families of eight persons or over are living each family in a single room.

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[1] *U.P. Government Report on Industrial Labour in U.P. Royal Commission on Labour, Evidence*, Vol. III, Part I, pp. 153–154.

Rent is a large item in the family budget of the poorer industrial workers. The average rent for Cawnpore (all income groups) comes to Rs. 3/2/– per month or 8·76 per cent of the total expenditure of the workers. As the income increases, the greater is the percentage of expenditure on rent.

Housing conditions are also often very unsatisfactory in villages in large parts of India, especially in regions where there is high rural density. Even in the Punjab, where the standard of farming and living is the highest in Northern India, the mud huts of the peasants show a terrible congestion. Such huts are "low-roofed, windowless, airless and miserable abodes." E. D. Lucas remarks: "Of course for nine months of the year the entire family practically live out of doors and the houses are used only as store-rooms and shelters in case of storm. In the winter nights of December to February they are so ill-clad that a closely-shut mud box (as someone called these huts) is their chief protection against the bitter cold." In villages in the eastern districts of the United Provinces which have been intensely surveyed the average number of persons living in such mud boxes varies from 8 to 12 and the inmates are found to sleep along with cattle and other live-stock. In large parts of Northern India the homesteads are seen to be huddled together at all angles in order to utilize the space as far as possible without any attention to drainage and ventilation, while the streets are narrow and tortuous and sometimes impassable owing to collection of refuse water from the house drains and the excreta of village cattle. To many peasants the huts are simply places in which one can stretch his legs and sleep in the night, and in several instances the loss of privacy blunts all sense of shame and decency. Men and women, young and old, sometimes may be seen packed together along with cattle and goats in winter. India differs strikingly from the West in that conditions of over-crowding and congestion are here worse often in the villages than in the towns. In Bihar and Bengal, however, we find less congestion on the village site, there being open spaces in the middle of the villages with a tank, temple or club-house. Or, again, each isolated hut belonging to a peasant family, with its cow-shed and out-houses, has an orchard or pond for its exclusive use.

It is only in the less crowded agricultural regions and isolated settlements of newly reclaimed areas that congestion and unsatisfactory housing conditions are unusual. With an increase of population pressure on the soil, deforestation has gone on for decades and this has also contributed in no small measure towards the lowering of the housing conditions in the villages by making the supply of timber and bamboo scarcer and scarcer.

INELASTICITY OF EXPENDITURE ON CLOTHING AND MISCELLANEOUS ITEMS

In India clothing needs are less imperative than in the Western countries where the loss of heat and energy due to inadequate clothing stiffens the muscles, causes illness and makes the Western working men inefficient. Scant clothing, on the one hand, will be an advantage for plantation labourers and miners working in the tropical heat and excessive humidity of Assam and Southern India. On the other hand, very few industrial workers can afford to wear shoes during working hours. The result is that workers render themselves liable to hookworm and other diseases, while foot-sores and ulcers are common, sometimes leading to serious consequences. Miners and plantation labourers who have sometimes to work in knee-deep water are particularly susceptible to both hookworm infections and foot-sores. The percentage of expenditure of the industrial workers on clothing and foot-wear and on household goods like bedding and utensils is higher in the lower income groups than that in the higher income groups.[1] This is because a minimum standard of decency is to be maintained as regards apparel, while certain ordinary earthenware utensils and torn clothes stitched together are also indispensable.

The following table illustrates this:

GROUP PERCENTAGE OF EXPENDITURE BY INCOME CLASSES

	Income group Rs. 15 and below Cawnpore workers U.P.	*Income below Rs. 20 Gondia miners C.P.*	*Income group Rs. 15 to Rs. 30 Cawnpore workers*	*Income between Rs. 20 and Rs. 30 Gondia miners*
Clothing . .	8·07	13·55	7·61	13·9
Bedding and Utensil	1·82	3·44	1·84	1·6
Miscellaneous	26·15	10·65	26·18	11·1

	Income Group Rs. 30 to Rs. 40 Cawnpore workers	*Income Group Rs. 30 to Rs. 40 Gondia miners*	*Income Group Rs. 40 to Rs. 50 Cawnpore workers*	*Income Group Rs. 40 to Rs. 50 Gondia workers*
Clothing . .	7·20	12·1	7·07	9·22
Bedding and Utensil	1·73	1·6	1·49	1·59
Miscellaneous .	29·18	16·2	31·31	31·16

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[1] *Report of the C.P. Government on the Standard of Living of the Working-class Family.*

Report of Royal Commission on Labour in India, Evidence, Vol. II, p. 202.

Such is the low standard of living that the percentage expenditure on the above items does not show the expected increase with an increase in income according to Engel's Law. On the other hand, miscellaneous expenditure, which includes expenditure on conventional necessaries and amenities of life, on education, medicine, amusement and repayment of debt, follows Engel's Law closely. The bulk of such expenditure is on the cot, bedding and metal utensils. No chairs or tables are ever found. A Dietz lantern, an umbrella, an electric torch, a bicycle, a tin trunk or a chauki exhibit all that comfort represents in slightly higher grades of workers and peasants. We read in the Central Provinces Government Report on the standard of living of working-class families: "Mosquito curtains are hardly ever used, and malarial fever is most common amongst these workers. Improvised bedding and limited numbers of cheap utensils do not promote cleanliness and the former is not adequate to ward off occasional dampness and exposure to changes of climate. Such conditions lower the vitality and decrease the power of resistance to disease." In other countries, however, it is this which represents a true index of the standard of comfort representing a much higher percentage of the total expenditure.

The percentage of expenditure of working-class families in Cawnpore on miscellaneous items is 27·91 and 19 per cent among the Gondia miners as compared with 48·12 and 56 per cent respectively on food. The expenditure on medicine is, however, negligible.

MONTHLY EXPENDITURE ON MISCELLANEOUS ITEMS OF WORKING-CLASS FAMILIES IN CAWNPORE

Name of Item	*Expenditure* *Rs.*	*AS.*	*P.*
Medical fee or medicines	0	0	7
Education	0	1	1
Intoxicants	0	4	5
Tobacco, etc	0	5	3
Amusements and Festivals	0	4	5
Indebtedness	2	14	10
Others	2	14	9
Total	6	15	2

It is true that for ordinary illnesses the workers go to the charitable dispensaries. But the average expenditure which represents mainly the expenditure of those families where there were cases of serious illness during recent months is extremely small. Expenditure on education is also insignificant and comes to Rs. 0–1–1 per family, or only ·9 per cent of the total expenditure. In income group "Rs. 15 and below" it is only 2 pies per family, but rises to Rs. 0–5–8 in the income group "Above Rs. 40 and up to Rs. 50." Poverty is the main cause which prevents the workers from sending their children to school. They cannot afford higher education for their children and therefore primary education, which they regard only as a step to higher education, is also neglected. Of the 729 wage-earners about whom information was collected on this point in Cawnpore, 76·8 per cent are illiterate and 23·2 per cent are literate. The proportion of literates to illiterates increases with the rise in the income of the family, except in the case of leather industry. In engineering there have been found more literates as the workers belong to higher caste who attach greater importance to education. Literacy was not tested. The statement of the workers was accepted on this point.[1]

EXPENDITURE ON EDUCATION

Certain interesting information relating to the proportion of the income of the peasants spent on education is available from 137 family budgets, collected by the Department of Economics and Sociology at Lucknow, in 1930, chiefly from among the workers of the cotton mill and the railway workshop. Since the workers are drawn mostly from the neighbouring villages the data will be of interest in this connection.

All budgets were classified into four income grades, viz. (1) below Rs. 15 a month, (2) between Rs. 15 and Rs. 30/- a month, (3) between Rs. 30/- and Rs. 40/- a month and (4) between Rs. 40/- and Rs. 50/- a month. There were 18, 93, 17 and 9 budgets respectively in each grade; the average monthly income being Rs. 13/13/8, 21/10/6, 34/7/10 and Rs. 43/1/5 respectively.

There was no expenditure on education in the first two grades. This is due to poverty, ignorance, or the facility of free education in the lower primary class, beyond which the children of the workers hardly go. Educational facilities in rural areas being limited to lower and upper primary standards, and the peasant being not in a position to send his children to the city for secondary education, the average monthly expenditure in these cases was nil. It appears in all probability that the lower primary education available in the village costs the peasant nothing. In the third grade, i.e., in the income group of Rs. 30 and Rs. 40 a month, the average monthly expenditure per family was one pie. Expressed in terms of percentage to total average income of the grade the expenditure would come to ·02. In the last income grade between Rs. 40 and Rs. 50 a month, the average family expenditure per month on education was Rs. 0/6/1. This would be ·88 per cent of the total average income.

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[1] *Royal Commission on Labour in India, Evidence,* Vol. II, Supplementary.

Taking all the workers together and calculating a weighted average expenditure for all groups, the amount spent per family per month was 4·9 pies out of an average income of Rs. 23/10/1 or ·11 per cent of the total average income for all grades. Weights were allotted according to the strength of numbers of families in each grade.

EXPENDITURE ON DRINK

We have noted the not inconsiderable expenditure on intoxicants. Drinking has become quite a common feature among the working classes—men and to some extent even women—affecting indirectly the standard of living and dietary by the drain on wages. In mines, plantations and dockyards, as much as 20 per cent of the wages is spent on liquor. Where workmen are recruited from the lower castes and tribes, intemperance is even a greater menace to the standard of living, increasing with the increase in income.

The introduction of the outstill auction systems by the Bihar and Orissa Government has since 1932 led to a great increase of drunkenness and consequent loss in efficiency and increase of accidents in the collieries. Formerly the aboriginal workers in the mines used to drink only fermented rice beer and *mahwa* liquor; now they are taking to the cheap distilled liquor, which is selling at 2as. per bottle. This compares very favourably with the previous price of 8 to 10as. a bottle for distilled liquor before the introduction of the outstill system. The loss in efficiency caused by increased drunkenness is clearly indicated by the diminution of raisings. The following comparative statistics in Kusundu Nyadee colliery illustrates this:

	March, 1932	*March*, 1934
Number of labourers	about 80	about 82
Number of tubs	488	403
Monday	50 tubs	37 tubs
Saturday	87 „	56 „
Intervening days	87–94 „	about 80 „

Accidents, crimes and convictions for drunkenness have also increased in the mining areas. Certain castes such as the Koiris, and communities like the Muslims, who generally refrain from drinking are now becoming addicted to drink. There is also an increase of casual sex relationship leading to a higher incidence of venereal disease, observes the Medical Officer in Dhanbad. Both he and the Health Visitor of the Jherria Mines Board of Health stress the fact that malnutrition has also increased, especially among women and children. In the homes the woman finds there is no money available for milk or vegetables. Both rickets and other deficiency diseases are prevalent in the coalfields. Abnormal under-weight is noticeable, mentions the Health Visitor, among the children, e.g., a one-year-old child weighing only 13 lbs. and a two-year-old only 10 lbs. Women are now taking to drink more than before and many abortions are brought about by drink. It is estimated that 90 per cent of the male labourers drink, spending about half of their earnings on this item alone. Mr. J. E. Copeland, a temperance worker, sadly comments that he has never seen worse conditions anywhere in India than those that confronted him in Bihar.[1]

COMPARISON OF EXPENDITURE BY INCOME GROUPS IN INDIA AND OTHER COUNTRIES

We may now compare the standards of living of industrial workers in different provinces of India by analysing the percentage expenditure for the principal items in the working class family budgets.

FOOD

	Cereals	*Pulses*	*Other articles of food*	*Total food*	*Fuel & lighting*	*Clothing*	*House Rent*	*Miscellaneous*	*Total*
United Provinces									
Cawnpore				48	9	8	9	26	100
Bihar									
Jharia	47·50	7·50	31·00	86	(free)	14·00			100
Jamshedpur	39·60	8·40	28·00	76	11·00	13·00			100
Bengal									
Jute mill workers in Howrah, Kidderpur, Matiabruz and Titagarh				71·3	4·74	1·72	7·5	14·01	
Jute mill workers in Kankinara, Birlapur and Matiaburz				66·1	8·0	8·2	4·8	14·2	
Central Provinces									
Nagpur	36·82	6·41	20·87	64·1	9·62	10·70	15·58		100
Jubbulpore	35·40	6·68	23·92	66·0	7·95	10·86	15·19		100
Bombay Presidency									
Ahmedabad	33·12	4·46	26·12	63·7	7·7	11·0	13·2	4·4	100
Sholapur	33·04	4·72	21·24	59·0	12·1	14·5	7·2	7·2	100
Bombay City	46·6	4·9	30·5	82·0	4·8	4·2	9·0		100

The above distribution of expenditure on different items may be compared with that in working-class family budgets in some foreign countries.

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[1] *An Enquiry into the Outstill System in Bihar and Orissa*, from which the above data have been summarised.

	Annual Income	*Food*	*Clothing*	*Rent*	*Heating*	*Miscellaneous*
China						
Peiping . .	S 210	58·2	4·6	9·4	11·8	16·0
Peiping . .	S2860	21·3	8·4	13·1	5·3	51·9
Japan						
Primary Poverty .	Y 200	65·0	6·0	12·0		17·0
Efficient Standard .	Y 960	35·0	10·0	17·0		38·0
Manual Workers .	Y1097	35·1	13·0	12·2	4·8	34·9
Land Workers .	Average	41·2	7·9	15·2	6·1	29·7
Industrial Workers .	Average	32·6	13·0	15·8	4·6	34·2
U.S.A.						
Farm Families . .	S1983	39·5	13·8	11·6	7·2	28·0
Lowest Bare Existence . .	S 744	48·2	18·2	19·3	6·7	7·6

Low Living and Health Standards

More than comparisons of *per capita* income, comparisons of the distribution of the percentages of expenditure on food, conventional necessaries and luxuries of life among different countries and economic groups offer an accurate clue to economic welfare. The *per capita* income does not indicate the actual distribution of wealth among the different classes, while the disparity of fluctuations of income and cost of living often hides the living standard. Details of consumption give a real idea of the standards of living of economic groups in different countries and among different classes. In the case of India, the percentage of expenditure on food is far higher than in the case of any other country in the world, including even China, as is evident in the family budgets collected for both land and urban workers. Not merely the very high percentage which food absorbs of the family expenditure, but also the preponderance of starch over proteins and the virtual absence of animal products, including milk and milk preparations, in the dietary indicate great privation if not actual destitution. The low standard of housing, the absence of ordinary furniture and utensils, the prevalence of illiteracy and ill-health and the high infantile and maternal mortality all point to the same direction.

The overwhelming majority of the rural population in India is used to malnutrition, ignorance and disease. Only 9·5 per cent of the population aged five years and over in India is literate, even according to the low standard adopted (capacity to write a letter and to read the answer to it). Compulsory education was introduced by the year 1934 in 166 urban and 3,138 rural areas, of which 2,982 are in the Punjab, though apparently with no very marked success. Among the rural population, especially in the classes from which industrial labour is drawn, the percentage even of mere literacy is much lower. The position of literacy calculated per cent of population aged five years and over for the major Provinces is given below:

Province	
Bengal	11·1
Bombay	10·8
Madras	10·8
Central Provinces	6·6
Punjab	6·3
United Provinces	5·5
Bihar and Orissa	5·3

The death rate is much higher than in the most civilised countries in the world. The following tables will be of interest in this connection:

DEATH RATE AND INFANTILE MORTALITY RATES (1933–1934)

Countries	*Death Rate*	*Infantile Mortality per 1,000 Births*
1. India	25·0	187
2. Great Britain	11·8	59
3. U.S.A.	11·0	60
4. Japan	18·1	125
5. Germany	10·9	66
6. France	15·1	69
7. Belgium	12·2	82

DEATH RATE AND INFANTILE MORTALITY IN INDIA (1933–1934)

ince	*Death Rate*		*Infantile Mortality Rate P.M. Live Births*	
	Rural	*Urban*	*Rural*	*Urban*
1. U.P.	25	38	175	271
2. Bengal	23	21	189	197
3. Bombay	24	26	156	219
4. Madras	25	17	192	198
5. Punjab	27	20	188	186

The over-crowding of agriculture, slow industrialisation and absence of opportunities of emigration, all have contributed to lower the standard of life in the face of a rapid multiplication of population. The low economic efficiency of workers, high average mortality and low expectation of life and close correspondence between economic conditions and the movement of birth and death-rates indicate the operation of the Malthusian checks. No greater proofs of the low standard of life of the Indian population can be adduced than these.

CHAPTER XIII

REMEDIES OF POPULATION PRESSURE

POSSIBILITIES OF IMPROVEMENT OF CEREAL YIELDS

The plane of living of the most considerable section of the Indian population which subsists on small farming is low enough, but the recent agricultural slump has contributed to depress it even further. The fall of prices of many crops which fetched a better price abroad has now limited the scope of intensive cultivation. Intensive cultivation has, however, great possibilities in the direction of the growing of more heavy-yielding cereals, beans, peas and fodder-crops, for which the principal requisites are better seeds and better fertilisers, and it is in the adoption of a more careful, meticulous combination of cereal and non-food-crop cultivation that we have chiefly to look for alleviation of pressure on the soil.

That India's rice and wheat yields leave much to be desired, even as compared with Oriental countries like China and Japan, is shown below[1]:

CROP YIELDS PER ACRE IN QUINTALS

	India	*China*	*Japan*	*U.S.A.*
Wheat	8·1	9·7	13·5	9·9
Rice	16·5	25·6	30·7	16·8

A fuller table gives the data for all crops for India and China and the world standards:

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[1] *Problems of the Pacific*, 1931, p. 70.

CROP YIELDS[1]

Product	*Yield (lbs. per acre)* *INDIA*	*CHINA*	*World Yield per acre* *BUSHEL*	*POUND*
Rice	988	2,433	32	1,440
Wheat	811	989	14	840
Barley	1,029	1,082	20	960
Jowar	626	1,158		
Bajra	452			
Ragi	972			
Maize	933	1,284	24	1,344
Peas and Beans	700	1,046	(13·7)	(824)
Sugar-cane	2,956	12,576		(26,600)
Cotton	110	204		161
Tobacco	1,179	1,288		776
Rape-seed	539	847		482

The Agricultural Departments in the various Provinces during the last few decades succeeded in introducing several improved varieties of crops. Rice covers a greater area in India than any other crop, about 35 per cent of the total cultivated area. In the case of rice the total area under improved varieties of rice has increased from 1,247,000 acres in 1930–1931 to 2,090,000 acres in 1932–1933. The total rice area in the whole of India in 1932–1933 was 83,000,000 acres. In the case of wheat, also, which occupies about 10 per cent of the total area under cultivation, greater progress has been made, improved varieties being now grown in about a sixth of the area cultivated. The estimated area under improved wheat in 1934–1935 was 6,489,484 out of a total area of 34,491,600 acres. As a result of researches improved varieties of cane to-day occupy about 70 per cent of the area sown.

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[1] The Chinese yields are derived from Cressey's table in *China's Geographic Foundations*. The Indian yields are based on the returns for the quinquennium ending 1931-32 (Appendix A. *Agricultural Statistics of India*). Column 4 gives pre-War averages from the *International Year-book of Agriculture*, 1930-31; figures in brackets which are not available on a world basis are U.S.A. averages. A bushel is figured as 60 lb. of wheat and soy beans, 56 lb. of maize, 48 lb. of barley and 45 lb. of rough rice.

The area under improved canes, which was 50,000 acres in 1923–1924, has increased to about 2,700,000 acres in 1933–1934. Taking all crops, the area under improved varieties is now about 16,000,000 out of about 232,000,000 acres, i.e., barely 9 per cent in British India, representing an increase of over 20 per cent in the course of the last two years. The corresponding area rose by 12 per cent last year. The total cropped area of 298 million acres in the whole of India shows the programme of research and its dissemination that has yet to be undertaken for the improvement of yields.

OBSTACLES TO INTENSIVE CULTIVATION

The progress in intensive farming is seriously hampered by various conditions and circumstances, among which should be mentioned lack of irrigation facilities, indebtedness, ignorance, the fragmentation of holdings and their pepper-pot distribution. The latter difficulties, which are due to the predilections of the peasant himself and the peculiarities of the law of succession, will not be easily overcome. On the other hand, an increase of population means a continuous fractionalisation of holdings which prevents the adoption of intensive farming.

In Madras a recent committee has reported that while population has increased, extension of cultivation has not kept pace with it in certain districts. Fragmentation of holdings has increased and the average area of holdings has become progressively smaller. The margins available for maintenance of the cultivators' families are either inadequate or nil.[1] Figures of yield as proportions of the standard prove that in not a single year of the decade 1921–1930 did the yield exceed 50 per cent of the standard expected in Baroda. Agricultural returns are only a fraction of the best possible and this is the case in Gujerat, which, rightly observes the Baroda Census Superintendent, "is the home perhaps of the most industrious and the most intelligent peasantry in India." In the United Provinces, Bihar and Bengal the proportion of undersized holdings is perhaps growing more rapidly than the variation of the population. Double cropped area has in large areas been reduced, as the tiny holding cannot bear the burden of successive croppings. Fragmentation of holdings compels the cultivator to give up the time-honoured practice of fallowing, which helps towards the natural restoration of soil fertility by nitrogen fixation. Where, on account of poverty, he cannot provide adequate manuring, the introduction of the new strains which have heavier yields leads to soil exhaustion. The cultivator responds to the situation by curtailing croppings.

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[1] Pages 98 and 99 of the Report; Quoted also in the *India Central Banking Enquiry Committee Report*, 1930–1931.

It is clear that if the adoption of intensive farming be jeopardised in the zones of human concentration in India by the fragmentation of holdings and their pepper-pot distribution, the energies of the Agricultural Departments in experimental work, propaganda and introduction of better seeds and better fertilisers, and in fact the greatest hope of alleviating pressure on the soil, will be frustrated in large measure.

Within limits, however, India's yields can yet be improved and brought nearer the standards of China and Japan through the use of better seeds and manures and the employment of otherwise idle or semi-idle labour. This could add enormously to the food-supply and release land for the cultivation of commercial crops for external markets or for internal industries, the expansion of which would greatly mitigate over-crowding in agriculture. But this increase of productivity would be futile if population continues to increase. Wheat yields in China and the U.S.A. are about one fourth greater than in India. No doubt climatic conditions in these countries are more favourable for wheat cultivation than in India. But in India the methods of growing wheat are less intensive than in China, where the crop is usually cultivated at least once and sometimes twice during the season, and in some regions may even be fertilised more than once. The superiority of yields of rice in China and Japan should indeed be an eye-opener for India. Rice both in China and Japan is cultivated several times during the season and much labour and expense are employed to add organic matter to the paddy fields. The meticulous attention to the details of soil preparation and drainage carried on almost exclusively by hand and the universal use of nightsoil and other organic wastes in rice cultivation in Japan account for more than double the yield of rice in that country as compared with India's yield. The output of rice for the five years 1921–1925 averaged 2,350 lbs. per acre in Japan. In India, in spite of certain improvement it was only 969 lbs. for 1922–1926, and diminished to 850 lbs. for the five years 1925–1930. Travancore shows the highest yield in India, 1,250 lbs. Spain and Italy give their average rice output as 5,000 lbs. and 3,000 lbs. respectively.

Plant breeding has greatly increased the yields of crops in India, particularly of wheat, sugar-cane and cotton; but if the indigenous agricultural practice does not change, the introduction of heavier yielding crop varieties, which make greater demands upon the soil, will upset the balance between crop-production and regeneration of soil fertility. This has been especially evident in the case of cane and wheat in some areas in India. India's crop yields, as compared with China and Japan, are reduced not only by the inability of the peasant to manure the land adequately, arising out of ignorance, prejudice or poverty, but also by the low draught capacity of her plough cattle and the resulting surface tillage, the country maintaining a large number of inefficient superfluous beasts. In India the cattle, fed on the straw and leaves of the crops, formerly returned manure to the land as a fertiliser. But the manure is now being burnt, due to the scarcity of fuel, while the excessive numbers of cattle population represent a most uneconomical drain on soil resources. In China, especially in the southern districts, cattle are scarce. Buck's studies indicate that oxen are found only on 52 per cent of the farms in North China and on only 31 per cent in the central area. Water buffaloes are absent in the north but are present on only 40 per cent of all farms in East Central China. He observes: "In some regions little work is done by animals, the soil being dug and prepared by hand-tools and more labour is done by men than animals." While nature resists the use of draught animals, man, who cannot obtain his manure, has turned to his excrements for keeping up soil productivity. India, on the other hand, maintains more than four times as many cattle per 100 acres of sown area as China.

RELATION BETWEEN CROP YIELD AND MAN-POWER

Neither of the Eastern countries can use Western farm machinery, which is excluded by the heavy population density as well as by the smallness and scattered distribution of the holdings. Even the plough may not be used and on many small farms in China and India the hoe or the spade is used. As with greater fractionalisation of holdings, the supply of agricultural labour increases, the use of the spade and hoe becomes more common. A monsoon country like India must establish a balance between agricultural labour and the growing times in cultivation. Where the season of agricultural activity is limited and machines cannot be used, owing to the smallness and scattered distribution of the plots, considerable numbers of labourers have to be employed for the agricultural operations, concentrated as these are in definite maturing periods. Thus the presence of a large mass of agricultural labourers indirectly contributes towards the low yields on the one hand and seasonal unemployment on the other. As an agricultural economist observes, "Where human labour is used, an organic relation exists between the labour supply and the minimum yield of the land to which it is applied." It must, however, be pointed out that any comparison between Indian and European or American yields of crops must be modified by the consideration that the yield has to be computed not for a single crop but for the entire year. Both in India and China, two, three and even four crops are grown on the same land in a single year. The total annual food-yielding capacity of an acre of land in India is much greater than in the Western countries. Thus the total yield of the year rather than a single crop yield should be the basis of comparison.

Secondly, the number of workers and live-stock, the ratio of the non-working to the working population, and the ratio of the number of agriculturists to those engaged in subsidiary or other occupations, must have to be reckoned with in considering the possibilities of improvement of crop yields in India. The problem of Indian agriculture is not merely to increase the total output but to raise the *per capita* yield. In other words, it is not the yield per acre, but the yield per mouth to feed on the land that matters in the country.

DISPARITY BETWEEN POPULATION INCREASE AND VALUE OF AGRICULTURAL PRODUCTION

The more thriftless sections of the population are crowding on to the land, where on account of economic pressure they are being left only with the more under-sized holdings. Recent movements of prices, especially of agricultural produce, have compelled, and will compel, more and more of even well-to-do peasants to reduce their standard of living. There had been a marked rise of prices of all commodities in India from 1917, rice and wheat prices showing an increase of 58 and 39 per cent respectively. The spell of agricultural prosperity, as the higher prices of wheat and rice from 1917 to the beginning of agricultural depression indicated, was accompanied by a sudden expansion of population, which largely explains the heavy piling up of the smallest age-group in the major Province of India. But prices began to fall about the time when the last decade opened. The main characteristic of the Indian price index numbers during the whole of the last inter-censal period was the larger fall in industrial prices as compared with agricultural prices. As a result the agriculturist was better off than the wage-earner, the artisan or the employee, and since he forms the most considerable majority in all Provinces, a rapid increase of population was not accompanied by economic stress. But agricultural commodities did not continue indefinitely to command prices relatively higher than manufactured goods. As a matter of fact, during the last few years quite the reverse tendency is shown by price indices, viz., the larger fall in agricultural prices as compared with industrial prices. Between 1928 and 1930 wheat declined by 24 per cent and rice by 33 per cent. In 1930 the heaviest declines in prices were shown by wheat (47 per cent on the basis of September, 1929) and oilseeds (43 per cent), along with cotton and jute; and in the next three years, 1931–1933, rice uniformly showed heaviest falls, going down by 58 per cent. Such a fall in prices of the chief cereals has led to a shrinkage of agricultural income in India by nearly a half in 1931–1932 as compared with 1928–1929. This must tell seriously on the Provinces that have added heavily to their commitments in the shape of extra mouths to feed. Economic prophecies, especially of a dismal kind, are risky and thankless, but in this case it is not difficult to forecast that a definite decline in the standard of living is to be expected in the Provinces which show the largest disparity between population increase and value of agricultural production. A decline in the present low standard of living in any Province cannot be thought of without grave

TABLE ILLUSTRATING DISPARITY BETWEEN POPULATION INCREASE AND VALUE OF AGRICULTURAL PRODUCTION

	Mean Density per square mile	*Acreage under food grains per capita*			*Increase or decrease of population 1921–31 per cent*	*Order according to population increase*	*Decrease of value (in 1932–33) of total production of the principal crops from 1928–29*	*Order according to decrease in agricultural income*
		1921	1931	*Increase or decrease per cent*				
Punjab ..	208	1·2	1·03	– 14	+ 14	I	36·8	VI
United Provinces	442	1·3	1·3	Nil	+ 6·7	VII	35·2	VII
Bihar & Orissa ..	379	1·3	1·5	+ 16·6	+ 10·3	III	58·2	II
Bengal ..	616	2·8	2·1	– 58·3	+ 8·3	VI	61·1	VI
Central Provinces and Berar	137	·9	0·7	– 16·6	+ 12·6	II	48·5	IV
Bombay ..	174	·9	0·9	Nil	– 1·8	VIII	30·4	VIII
Madras ..	329	1·4	1·6	+ 16·6	+ 8·5	V	45·0	V
Burma ..	63	1·01	1·01	Nil	+ 11·1	IV	35·5	III
India ..	195	·58	·69	+ 9·2	+ 10·5	—	47·5	—

apprehensions, as the population as it now stands appears to be exceptionally vulnerable, its natality and mortality showing a close correspondence with agricultural conditions. Now the latter have not been unfavourable in India as a whole during the past few years. When a famine comes, or a virulent epidemic sweeps over the country, the Malthusian equilibrium will be re-established through Nature's cruel and haphazard methods, which will be more devastating in their operation in the countryside than our recent famines and epidemics.

The phenomenal multiplication of population between 1930 and 1935 in the midst of the agricultural depression could be explained largely by the proportionate increase of births towards the end of the last Census decade, and hence of persons now in the reproductive age. The number of married females increased by two to four per mille between 1921 and 1931 in the principal Provinces. This increase was due to the agricultural boom between 1917 and 1927 and the sudden and even astonishing recovery in the birth-rate in some Provinces after the influenza epidemic. Even without any calamities like famine or a serious epidemic population pressure normally leads to an outward flow of emigration, but industrial depression in the country and the slump in rubber, tea and mining production in Ceylon, Burma, Malaya and the Dutch East Indies, has discouraged population movements both inter-provincial and overseas.

INTER-PROVINCIAL MIGRATION

Migration, which is the most spontaneous and quickest means of mitigating population pressure has been in recent years much reduced, and overseas emigration is now negligible. The total number of emigrants from the United Provinces was reduced from 15 lakhs in the decade 1901–1911 to 9·7 lakhs in the decade 1911–1921 and 10 lakhs in the decade 1921–1931. Thirty years ago, we read in the *Famine Report*, 1908, it was commonly said that there was not a single family in the Benares division which had not at least one member in the Provinces of Bengal, Assam or Bihar. Even now the emigration from the eastern districts of the United Provinces is not inconsiderable. Such migration has a further result in securing for the families left behind an additional source of income provided by the emigrants. Many districts which are entirely rural and possess hardly any important industry received large money-orders in 1928–1929: viz. Gorakhpur (60 lakhs), Azamgarh (54¼ lakhs), Jaunpur (53¾ lakhs), Fyzabad (48 lakhs), Sultanpur (43¾ lakhs), Partabgarh (35½ lakhs) and Ballia (30½ lakhs).[1] Migration movements have been considerably attenuated in recent years, and this has contributed in some measure to aggravate the agricultural depression.

EMIGRATION FROM THE UNITED PROVINCES, 1921

Agricultural regions in the United Provinces, India	*Percentage of provincial Area*	*Percentage of provincial Population*	*Population (000's omitted)*	*Density (rural portions only)*	*Migrations (000's omitted)*	*Pe to*
Indo-Gangetic Plain, West	22·50	26·80	12·146	430	+144	1·2
Indo-Gangetic Plain, Central	21·20	26·30	11·920	477	+242	2·0
Indo-Gangetic Plain, East	7·00	11·50	5·248	648	+376	7·0
Sub-Himalaya, West	12·00	17·00	7·730	584	+ 58	0·7

[1] *Report of the U.P. Provincial Banking Enquiry Committee*, p. 31.

In Bihar and Orissa also the number of emigrants was reduced from 15 lakhs in 1901–1911 to about 13 lakhs in 1921-1931. It was only in Madras that the number increased from 6 lakhs in 1921–1931. Recently, however, the decline in the planting industry has resulted in large numbers of returns.

I. *Provinces which send out emigrants*	*Gain or loss per mille of population*			*Percentage of sown to total area* (1931)	*Population per 100 acres of cropped area* (1931)
	1911	1921	1931		
Bihar and Orissa	− 37	− 40	− 37	47	152
United Provinces	− 15	− 20	− 21	53	135
Madras	− 30	− 35	− 20	37	140
II. *Provinces which receive emigrants*					
Assam	+114	+152	+144	16	150
Burma	+ 48	+ 52	+ 40	11	84
Bombay	+ 14	+ 18	+ 19	41	213
Bengal	+ 30	+ 26	+ 12	49	113
N.W.F. Province	+ 31	+ 39	+ 6	27	61
Central Provinces	+ 27	+ 13	+ 4	39	84

Bengal in spite of her high rural density receives a considerable number of immigrants from the up-country and Madras, who flock especially to her mill towns and cities. The social circumstances that account for a considerable volume of immigration (which, however, shows progressive decrease during the last two decades), are peculiar to Bengal, where the land-system and the literary pursuit of the *Bhadralok* classes have proved unfavourable for development of industry and trade by the sons of the soil. We may conclude generally that the United Provinces, Bihar and Orissa, Bengal and Madras have all overstepped an equilibrium density, and it is the heavy and differential population pressure which explains emigration from these areas to the less thickly populated Provinces. Amongst these. Assam, Burma, Central Provinces and the North West Frontier Province may be said to be under-populated, although an optimum density may have been outstripped even in some under-populated Provinces.

Like Japan, India should adopt a scheme of assisted emigration overseas, defraying the cost of passage to emigrants to foreign countries which are developed or undeveloped, and which may encourage agricultural colonisation.

The British Empire, the population of which is ninety per cent non-white and which now comprises the greater part of the undeveloped sections of the earth, should deal with the Indian emigration, like tariff and industrial co-ordination, as essentially an Imperial problem. The solidarity of the British Empire demands Imperial economic planning, which cannot be successful without a modification of racial discrimination in the policy of Indian emigration in Australia, South and East Africa. For as long as 377 millions of Indians are not freed from the cramping effects of economic pressure and soil exhaustion on their two-acre holdings, their low purchasing power will prevent the industries of Great Britain from emerging successfully out of the present depression. The Imperial Conference has the appropriate machinery that could, boldly used, formulate reciprocal agreements between the different parts of the Empire, which might, through a more liberal emigration policy, increase the Imperial food supply and trade, and level up the standards of living among different peoples within the Empire.[1]

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[1] The subject of Indian emigration has been recently discussed in my work, *Migrant Asia: a Problem in World Population.*

DISPARITY BETWEEN POPULATION INCREASE AND INDUSTRIALISATION

Industrial development in India as a whole is still exceedingly tardy. Only 5 millions may be taken as the figure of organised labour out of a total of 154 million workers. The daily average number of hands employed by establishments to which the Factories Act applies is only 1,610,932. In Madras the number of operatives in factories is only 101,655 out of a total of about 29 million workers. Out of 23½ million workers only a lakh (i.e., 0·5 per cent) are employed in organised industries in the United Provinces. The following table shows the disparity between population increase and industrialisation. A grave economic situation, in the face of increasing population pressure, is indicated by the decline of the relative proportion of industrial employment during the last three decades.

	1911	1921	1931	*Percentage of variation* 1911–31
Populations (in millions)	315	319	353	+12·1
Working population (in millions)	149	146	154	+ 4·0
Persons employed in industries (in millions)	17·5	15·7	15·3	−12·6
Percentage of workers in industry to the working population	11·0	11·0	10·0	− 9·1
Percentage of industrial workers to the total population	5·5	4·9	4·3	−21·8

That de-industriation is going on is indicated by a fall in the numbers of actual workers in the principal industries since 1911.

Number of actual workers	1911	1921	1931
1. Textiles	4,449,449	4,030,674	4,102,136
2. Industries of dress and toilet	3,747,755	3,403,842	3,380,824
3. Wood	1,730,920	1,581,006	1,631,723
4. Food industries	2,134,045	1,653,464	1,476,995
5. Ceramics	1,159,168	1,085,335	1,024,830

During the last two decades the average daily hours of labour have been reduced in the Indian factories from 12 to 9, which implies the employment of a larger number of workers for the same jobs. Thus, calculated on the old basis for the sake of comparison, the present number of labourers even would have been reduced further by 25 per cent. The increasing population, indeed, is not being absorbed in industries at all. On the other hand, the dependence of the population on agriculture shows a steady increase as shown below:—

	1891	1901	1911	1921	1931
Percentage Population supported by Agriculture	61	66	71	73	73

The situation has considerably deteriorated as a result of the world economic depression on account of which industrial unemployment has rapidly increased. It is only in the sugar industry, which has been aided by a tariff, that the employment of workers has rapidly increased. But sugar employs on the whole only 200,000 workers. In a large number of industries, whether organised or small establishments, the decline in numbers means a greater over-crowding in agriculture, which aggrav poverty, unemployment and indebtedness. Betw 1911 and 1941 the population will, it is estimat have increased by approximately 85 millions. Even with an addition since 1931 of 1·2 millions as industrial workers, who will be employed by the sugar, textiles, leather, match-making and food industries, the number of industrial workers will not exceed 16 millions. On the other hand, the working population will probably increase by about 20 millions. Thus the occupational maladjustment is expected to be even graver in the future:

	1911	1921	1931	1941 (*estimated*)
Population (in millions) ..	315	319	353	400
Working population	149	146	156	170
Persons employed in industries (in millions)	17·5	15·7	15·3	16
Percentage of workers in industries to the working population	11·0	11·0	10·0	9·4
Percentage of industrial workers to the total population	5·5	4·9	4·3	4·0

Even in Bombay, which is the most industrialised of the Provinces, the present slump has in no small measure retarded industrial expansion. It has not merely resulted in a decline of the population of Bombay City, due to large numbers having been forced back on to the land, but has thrown upon agriculture a greater burden than before. While there has been a 7 per cent increase in the number of persons employed in agriculture, industry shows a decrease of 5 per cent in the number employed since 1921 in the Bombay Presidency. In Bihar and Orissa, despite the increase in the total population by 4·4 millions from 1921 to 1931, there has been a fall of over 1 million, or roughly 6 per cent in the number of actual industrial "workers" in the Province. Both in the Punjab and the Central Provinces as well, the total number of persons following industrial pursuits has slightly diminished in the last decade. In Madras alone the number of workers in industry increased by 3 per cent, the chief contributor being textiles, accounting for an additional employment of 70,000 persons; but the percentage of the population supported by agriculture in 1931 remains about the same as in 1921 (71 per cent).

In Bengal the number of workers in industry more steadily and uniformly diminished.

DECREASE OF INDUSTRIAL EMPLOYMENT IN BENGAL

	1911	1921	1931	*Percentage of variation* 1911–1931
Population (in millions) ..	46·3	47·5	51·0	+10·0
Working population (in millions)	16·2	16·8	14·7	— ·90
Number of workers in industry (in millions) ..	1·7	1·7	1·3	— ·23
Percentage of workers in industry to the working population	10·5	10·1	9·0	—14·2
Percentage of industrial workers to the total population	3·9	3·7	2·5	—35·8

Between 1930 and 1931 alone the number of workers in registered factories decreased by 83,438.

SOME FALLACIES OF OPTIMISM AND PESSIMISM

The great and increasing occupational disbalance in the country can only be corrected by a forward policy of industrial planning aided by a protective tariff. Some economists postulate prosperity by referring to budget surpluses of the Central Government, disregarding, however, Provincial deficits; or to improvement of credit abroad without alluding to the effects of depression on bank rates and the increase of agricultural indebtedness; or, again, to the increase of industrial output without reference to the fall in prices or the proportionate increase of the labouring population. All this is like looking at slides of cross sections through a microscope without seeing the processes of life as a whole. Some economists, again, estimate that even if the industrial production could be doubled during the next ten years the additional industrial employment created thereby would absorb only 1·6 per cent of the agricultural workers; and they are, therefore, pessimistic about a policy of industrial protection. No doubt the whole of the surplus agricultural labour cannot be absorbed in industries, but to argue from a tardy industrial development, which is itself due to lukewarm and inadequate protection and to lack of planned industrial and financial policy, that the future growth will be equally slow is misleading. Some economists, again, estimate that a complete production in India of all the articles at present imported would only mean a yearly increase of productive power equal to less than Rs. 4 per head of the population. No doubt the increase in productive power per head would not be commensurate with our needs, but in view of widespread unemployment and poverty even this small increment may be welcome. A slight improvement in the standard of living may lower the number of births and increase the *per capita* income in a relatively larger proportion than the increase of real production. Moreover, the development of existing industries and the establishment of various new industries may open up other useful avenues of employment such as connected services of transport, marketing and management. The development of ancillary industries may also provide additional employment. Besides, some of our exports represent important raw materials of agricultural industries, such as oil-seeds, fibres, tobacco and hides and skins. The development of agricultural industries with these raw materials would add considerably to the productive power per head which is at present uneconomically utilised. The argument for the diversification of Indian economic life has gained considerable strength in the present period of agricultural depression. With a variety of occupations, drought and failure in agriculture would not have meant such aggravation of poverty and unemployment and dislocation of credit and finance. In a period of glut in agricultural production in the world the fall in income from agriculture might have been offset by better prices of industrial products.

Such industrialisation would not be at the expense of agriculture but would rather aid towards better farming and agricultural marketing. Not merely the manufacture of vegetable oils and fats but sugar, soap, tobacco, hemp and silk factories in villages may promote a better occupational distribution of labour supply. Many villages have specialised in certain distinctive arts and handicrafts, the re-organisation of which may release the pressure on the soil. Rural electrification may make numerous small scale industries available to the peasant either as a substitute to agriculture or as supplementary to it.

Fruit growing and market gardening may solve the problem of uneconomic holdings, cultivated as these may be by the spade rather than by the plough on gardening lines. But these are yet in the region of possibilities in India. Cattle-breeding and dairying in association with small-scale farming have developed only in the canal colonies of the Punjab, the Ganges Doab and North Gujerat. Small scale trade and rural industries are found as excellent substitutes for agriculture or as supplementary to it only in the hydro-electric zones in the Punjab, United Provinces, Madras and Bombay. In the U.P. power for agriculture in the west of the Province is now supplied hydro-electrically, and the tube wells are very definitely remunerative. The industrial demand for electricity has been the greatest. Next, the agricultural demand for working tube wells, sugar-cane crushers, and so on. Industrialisation in the villages can be greatly promoted by hydro-electricity in India, absorbing the surplus of the agricultural labour population or maintaining a class of half-and-half labourers, half-agricultural, half-industrial as in Belgium and Czecho-Slovakia. A general improvement of technical efficiency and standard of living in the country-side can proceed most easily from the establishment of sugar mills, oil mills, rice, tobacco or soap factories and the rehabilibation of cottage industries by grafting into them large co-operative business as in Germany or Switzerland. As concentrated urban industrialisation has fostered population increase by creating a steady continuous demand for cheap labour and breaking up the older social order, the decentralisation and ruralisation of industries would tend towards a general improvement of the standard of living, check multiplication and the disintegration of the stable forms of family village and social structure in India associated with the present unhappy phase of economic development in the country.

CHAPTER XIV

NEW SOCIAL ATTITUDES

THE SMALL FAMILY HABIT IN THE PAST

The population problem in any country is a feature of a general social crisis. Peace and security of rural life and introduction of public hygiene and sanitation have been the major factors of population increase during the last half century in India. But what have contributed towards transforming this multiplication into a real economic and sociological problem are the profound changes in the Indian social and village structure. The disruption of the joint family, the breakdown of the village community, the fractionalisation of holdings, the rise of new classes of land intermediaries and agricultural proletariat, the disintegration of caste government, all have tended to loosen the social fabric. Means of social control which brought about an easy, stable adjustment of numbers and occupations to standards of living are no longer efficacious. The ancient polity demanded *achar* or the social obligation of service, and taught the great lesson of each for all and all for each, extolling the virtues of austerity and liberality. So did the ritual of the family, the *Kula* and the *Jabi Dharma*, which gave every individual his station and standard of living, every social group its occupation and profession, and every occupation a stability, while at the same time providing religious sanction for the poverty and inequality as they appear in life. Neither the joint family nor the caste nor the village body politic nor the time-honoured *dharma*, now supply effective social standards which keep down numbers; while the changes in agrarian distribution have created a disparity of wealth and opportunity, encouraging niggardliness among higher and improvidence among the lower social strata. Undue sub-division of holdings has been a new evil and this has eliminated the old agricultural advantages of a large family. Tiny holdings nourish a large proportion of idle and semi-idle labourers. More mouths to feed also accompany more hands to work but the hands are idle. The ancient traditions of forbearance and self-control, Malthus's moral restraints, are no longer operative amongst the lower social strata. Malthus emphasised the postponement of the age of marriage accompanied by strict continence. In India one of the significant factors in the population problem is the social sanction and encouragement of child marriage. In the past, India had developed the planned family system and the small family was the general rule. As in China or Japan in the past, the limited family habit depended upon innumerable social canons and regulations, which governed daily life and practice, including conjugal relationship. Such customs also included the postponement of marriage for large sections of the population and prolonged abstinence from intercourse for married persons, who were bound to conform to certain religious injunctions in this regard. Hypergamy, a heavy bride-price and an expensive and elaborate marriage ceremony, also contributed towards less frequent marriages. A large section of the population, again, lived a single life in *maths*, monasteries and convents. The greater the number of these in a period of religious revival in India the smaller was the number of births. Infanticide, especially the exposure of female babies, was, also, a common practice in India among the castes who practised hypergamy. Prostitution, which, also, Malthus regards as a check on the growth of numbers, has been associated in South and Western India with temple girls forming an honoured priesthood, devoting themselves to devotional song and dance. The small family tradition, the postponement of marriage, the religious taboos and injunctions governing marital intercourse, and the social emphasis of celibacy, checked unrestricted increase of numbers.

THE INTRODUCTION OF CHILD MARRIAGE

The results of the Mohammedan conquest proved, however, disastrous for the small family system in India. Infant marriage, which was unknown in the epic and Buddhist literature and did not play any part until the Gupta period, began to prevail and to be widely adopted, especially in the central areas, which were most powerfully affected by the Mohammedan influences, in contiguity on one side or the other in a line drawn from Sind to Rajmahal. Infant marriage was promoted by the desire of the family to get its girls safely mated to suitable husbands in an age when there was danger of an improper alliance due to the Mohammedan contact. But since then child marriage has been practised most by the lower social strata; the Brahmins, Kayasthas and the intermediate castes being less addicted to this practice, except in the Central India Agency and Hyderabad. Since it is these lower castes who also allow their widows to marry again, the result has been an unrestricted multiplication in their case. As the industrial revolution promoted population increase in Europe in the nineteenth century and in Japan in the twentieth, the continued subdivision of holdings making agriculture less and less remunerative, and de-industrialisation due to the decline of cottage industries and handicrafts, are to-day discouraging thrift or homespun prudence and promoting multiplication. Climate also is a factor in over-population by reducing the age of puberty. In India girls attain puberty between 12 and 15 years and reproduction has not been unusual at 13. Laxmibai Rajwade, following the method adopted by the Age of Consent Committee, estimates 43·7 per cent, as the proportion of girls married in India below the age of 15. The proportion of girls married or widowed between 10 and 15 to the total number of girls of that age period is 39·1.[1] Owing to the practice of infant marriage pre-puberty consummations and violations of the Law of Consent are not unusual. "Cases are not uncommon," says a witness before the Age of Consent Committee, "in which girls bring forth six or seven children before they attain their eighteenth year." The period of lactation also appears to be reduced and there are shorter intervals between child-births among low castes than among high castes. Social customs and taboos do not adequately protect the Indian mother against the demands of the house, the field, and the cattle shed. Though child-bearing is frequent, the woman is not relieved from toil and drudgery. "Enquiries into a large number of cases," observes the Age of Consent

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[1] *Our Cause*, edited by Shyam Kumari Nehru, p. 78.

Committee, "show that when the marriage of young people is consummated at an early age, say, when the boy is not more than 16 years or the girl is 12 or 13, a fairly large percentage of wives die of phthisis or some other disease of the respiratory organs, or from some ovarian complication, within 10 years of the consummation of marriage."

As a matter of fact, apart from the neglect of female children, too early and frequent maternity, ignorant midwifery, dangers of child-birth and disorders and diseases continuing as a result of subsequently bearing too many and too frequent children, have all contributed, in the absence of selective epidemic diseases, towards a higher death-rate amongst females than amongst males in India, especially in the reproductive ages. The risk which the Indian woman runs at her first child-bearing is aggravated later when her strength has been broken by her having borne too many children at too short intervals. The net result is a deficiency of females in India as a whole, and in the higher castes in particular, which is on the increase. It is because early marriage and maternity are so widespread and their effects are so disastrous upon health, mortality and the biological condition of the population, that appropriate and cheap devices of birth-control, derived by the rural population from materials in its own domestic surroundings, are necessary, so that contraception may be applied until the man has attained the age of say 21 or 23 and the woman the age of 20 or 22 in India.

[illegible] COUNTRY-WIDE BIRTH-CONTROL PROPAGANDA

It is sometimes suggested, and that on the basis of historical experience, that there is only one way in which we can seriously reduce the Indian birth-rate, namely, by raising the standard of living. But with a mere economic conception of the standard of living, to depend upon an uplift of the plane of living for an automatic decrease of the birth-rate is putting the cart before the horse. The introduction of improved seeds, fertilizers and implements, change in marketing methods or even a reform of land tenures, these are all thwarted in India by the fractionalisation of holdings and cheap and inefficient labour in the countryside, which are the indirect results of population increase. On the other hand, mere increase of production cannot now solve the problems at present inherent in the situation, such as too low a standard of living, too high a proportionate cost of labour and crop yields, which should be increased. The situation is very much similar to that in China. Unless some check is placed upon population growth, any other remedy tends to be only temporary, as in the latter country, for population will rapidly rise again to the maximum number of persons the land will support.[1] The offensive against illiteracy is similarly baffled because population outruns the capacity of education. The dead weight of illiteracy among the backward castes and the Muslims of India makes the problem of its removal a formidable one both from financial and administrative points of view. As population outruns faster the educational facilities that may be provided while the taxable capacity hardly increases, it is clear that the pressure of population cannot be viewed merely in relation to the food supply. As a matter of fact, in India the present attitude of most Provincial Governments in deferring schemes of mass education and sanitation, agricultural improvement and rural uplift generally, and in lowering for the time being the accepted standard, is entirely due to an expanding population which makes readjustments more and more difficult. A rational family planning and education of the masses in birth-control must be accepted as the most effective means of combating population increase. The small family system, deliberately planned and integrated with other habits and traditions which regulate different sides of domestic life, must now be adopted in India as the social and ethical norm, and such a custom as polygamy, which, by encouraging a large family, has become an obvious economic misfit, must be declared illegal. At the same time, without better farming, an increase in the agriculturists' income, industrialisation and absorption of farm hands and casual labourers in small industries and workshops, an improvement in the standard of living on the part of the masses cannot be effected; for this alone can create the mental attitude that is the sole bulwark of the small family habit. Marriages, births and deaths are now regarded as acts of God in India. Such fatalism has to give place to a consciousness of individual responsibility which alone can express itself as a policy of control of numbers deemed obligatory by the individual and sanctioned and prized by social conventions. Birth-control is, after all, a practical device which is safer and surer than the methods now in vogue. Early abortion is not uncommon in India and there is also evidence that in the villages some crude and casually found methods of birth-control are in use among the women. While birth-control is adopted in the higher social circles in Bombay, Bengal and Madras, it is not unknown in some rural areas. Contraception of a crude kind has, for instance, been observed among the Goudans of Salem, apparently in order to prevent the undue growth of families and the consequent fragmentation of holdings and weakening of the joint family system and influence.[1] In the Punjab, especially in the new canal colonies, family limitation with a view to prevent fractionalisation of holdings is not unknown. Darling mentions that in a village in Gurdaspur a midwife for the last 15 years had rendered 150 women incapable of bearing any more children. None was treated except with the husband's consent and unless there were three sons.[2]

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[1] See Buck: "Agriculture and the Future of China," p. 113, *The Annals*, November, 1936.

Birth-control could effectively regulate increase of population and help towards a solution of the population problem in India only when and as soon as the customs and attitudes of the masses towards the family support it. Nor should we exaggerate the dangers of the growth of casual sex life and weakening of moral influences as the result of the spread of birth-control. In the atmosphere and circumstances of India the development of casual sex relationship associated with a wide vogue of contraception has to be greatly discounted. As birth-control gradually spreads from the cities to the rural areas it will contribute towards decreasing the size of the family and preventing strain on the family income and the health of the mother. Why should Indian peasant women who obtain education, leisure and a few luxuries of life in the future, and lose only say 5 or 10 per cent of their infants in the first year, bear at the same rate as now when they lose 20 or 30? The present spawning accompanies mud hovels shared with cattle and goats, one-third of the babies dying in infancy, thin gruel and loin cloth for the survivors, widespread abortion and appalling maternal mortality. As there is desire for better food and higher standard of living and for giving the children better opportunity for advancement, as women gain in enlightenment and self-consciousness and as men rid themselves of the over-awing authority of religious injunctions which were the outcome of remote spacious times and which have now become obvious misfits, the prejudice against "interference with nature" will yield to economic necessity. Modern education, medicine and public hygiene have reached the Indian village, and as these spread more, birth-control will shock the people less and what Ross calls "an adaptive fertility" will relieve the present heavy population pressure. Nothing is more important than this adaptive fertility for securing in India the economy of reproduction, the absence of which has made it more and more difficult to raise the standards of farming and living, has led to chronic unemployment in the fields and in the cities and has brought about an appalling waste of life which is spilling on all sides. On the other hand, it is only when the fertility of India's workaday millions becomes somehow adapted to the present situation of definite and increasing food-shortage, through their forethought and new attitude in the matter of the family, that India can look for a fresh advance in the way of improved agriculture, education and mass sanitation in her villages. These reforms will be followed up as in the West by a reduction of mortality and an increase of average longevity; and thus, as more and more of human fertility is left to lie fallow, there will be an enrichment of life, and of its equipment and experience on all sides.

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[1] *Census Report of Madras*, 1931, p. 46.

[2] Quoted by Shirras: "The Population Problem of India," *Economic Journal*, March, 1933.

CHAPTER XV

DYSGENIC TRENDS OF POPULATION

DISPARITY IN THE GROWTH OF LITERATE AND BACKWARD SOCIAL GROUPS

In India for several decades the intellectual social groups, by reason of such dysgenic customs as rigid hypergamy and endogamy, as well as on account of a natural paucity of females, are exhibiting either a smaller natural increase or an actual diminution in numbers, as in the United Provinces. On the other hand, the less literate and backward social groups are more progressive demologically, and these threaten to swamp the cultured stocks, especially in the prosperous areas in the Ganges plain. As in the West, the most fertile social strata in India are inferior, but nowhere is the disparity between fecundity and culture greater than in Northern India.

Throughout Northern India the decay of the literate caste Hindus and the rapid multiplication of the less literate and backward Hindu castes and of Muslims may threaten an economic and social crisis in the coming decades. A striking disparity in the growth of different sections and social groups may profoundly alter both the social and political outlook in the country.

Let us analyse the social composition of Northern India. In the Punjab the Hindus represent only 30 per cent of the total population, the Muslim proportion being more than half. Both in the United

Provinces and Bihar and Orissa, the percentage of the Hindus to the total population is about the same, 84 per cent, the Muslim proportions being 14 and 10 per cent respectively. But in Bengal, again, the Muslim dominates, forming 54 per cent of the population, and this dominance increases as we reach the prosperous districts in Eastern Bengal, where he represents 65 to 75 per cent of the population. Similarly, the backward Hindu castes increase in proportion as we proceed towards the east; they represent 31 per cent of the Hindus in the United Provinces and 33 to 45 per cent in Bihar and Bengal. Everywhere the Muslim and the depressed castes are much less literate but increase faster than the Hindus, especially towards the east. In Eastern Bengal the Muslim is a convert from the lower-caste Hindu, and shows a distinctly lower level of culture, living, however, under the most favourable natural conditions.

DISPARITY OF GROWTH OF UPPER AND LOWER CLASS HINDU AND MUSLIM COMMUNITIES

	Percentage of the total population		*Male Literate per mille*		*Percentage of Hindus Depressed Classes*	*Literate per mille*	*Growth per cent 1881–1931*	
	Hindus	*Muslims*	*Hindus*	*Muslims*			*Hindus*	*Muslims*
Punjab	30	52	166	58	16	8	6	51
United Provinces	84	14	91	97	31	5	7	21
North Bihar	82	17	102	100	33	6	7	13
South Bihar	90	10					12	20
Bengal	43	54	263	116	37	50	23	51
Eastern Bengal	27	71			40		39	87

Throughout Northern India the literate castes now show a rate of growth which is less than that of the backward Hindu castes and that of the Mohammedans. In the Punjab the Hindu community as a whole has actually declined by 6 per cent during the last 50 years, and the Muslim community increased by more than 50 per cent. In the United Provinces all the literate castes have actually declined in numbers during the last 30 years. The Brahmins and Rajputs have diminished by about 5 and the Kayasthas and Kurmis by 10 and 12 per cent, while the Chamars and Ahirs, who now aggregate more than the total number represented by the four literate castes, have increased by 6 and 2 per cent respectively. Among other backward castes, the Pasis, Gadarias and Lodhs have increased by so much as 18, 9 and 5 per cent respectively. All the backward castes everywhere are more fecund, and it seems that in the future population will be largely recruited from the culturally inferior classes and communities. Where the percentage of male literacy is less than 10, the social group may be regarded as backward under the present social conditions in India.

DISPARITY OF NATURAL VARIATION OF ADVANCED AND BACKWARD HINDUS AND MOHAMMEDANS IN NORTHERN INDIA

	Total number (omitting 000's)	*Percentage of Literacy of males aged 7 years and over*	*Percentage variation* 1901–1931
	United Provinces		
Brahman	4,556	29·3	–4·8
Kayastha	479	70·2	–9·3
Rajput	3,757	18·3	–4·9
Kurmi	1,756	5·4	–11·8
Chamar	6,312	·6	+6·4
Ahir	3,897	·2	+1·3
Pasi	1,461	·5	+17·8
Gadariya	1,021	1·1	+8·6
Lodh	1,099	2·4	+5·3
Mohammedan	7,181	9·7	+7·1
Hindu	40,585	8·9 (Age 5 and over)	+0·1

DISPARITY OF NATURAL VARIATION OF ADVANCED AND BACKWARD HINDUS AND MOHAMMEDANS IN NORTHERN INDIA—*contd.*

	Total number (omitting 000's)	*Percentage of Literacy of males aged 7 years and over*	*Percentage variation 1901–1931*
	Bihar		
Brahman	2,101	35	+19·9
Kayastha	383	60	+5·5
Rajput	1,412	21	+9·3
Goala	3,455	3·7	+10·4
Santal	1,712	1·2	+31·9
Kurmi	1,455	9·3	+18·3
Koeri	1,302	—	+4·5
Chamar	1,296	·9	+21·2
Dosadh	1,291	1·2	+12·8
Jolaha	984	6·6	+23·9
Mohammedan	4,284	10·7	21·0
Hindu	35,206	9·9	14·6
	(including Orissa)	(Age 5 and over)	
	Bengal		
Brahman	1,447	64	+24·1
Kayastha	1,558	57	+58·3
Mahisya	2,381	32	+21·9
Namasudra	2,094	14·5	+13·3
Rajbangsi	1,806	9	+4·8
Jolaha	270	13·3	+39·5
Mohammedan	27,810	11·6	24·7
Hindu	22,212	25·9	11·3
		(Age 5 and over)	

The Mohammedan, who is less literate than all the upper-caste Hindus everywhere, and in Bihar and Bengal less than even some of the backward castes such as the Khandaits, Telis, Jaliya Kaibarttas, Mahisyas and Namsudras, increased by 21 per cent during the last 50 years, while the Hindu has declined by 6 in the Punjab and increased by about 7 per cent in the United Provinces, 5 per cent in Bihar and 23 per cent in Bengal. During the last 50 years the Mahisyas, Namasudras and Rajbangsis of Bengal increased by 18, 33 and 100 per cent respectively.

EFFECTS OF WIDOW REMARRIAGE AND POLYGAMY ON POPULATION

The enormous growth of the Muslim population is due no doubt to widow remarriage, to polygamy, to later consummation of marriage than among most Hindus and probably also to the difference of food and economic habits. Among the Muslims polygamy obtained a religious sanction due to exceptional circumstances of tribal warfare and nomadic living imposed upon the people by the regional conditions in Arabia. The Muslims have taken to polygamy in India as a matter of social habit. Polygamy, however, contributes to reduce longevity of their females and increase the mortality of their children, in comparison with the Hindu community. The mean ages for the Hindus and Muslims for the different Provinces of India given below show that in every case the expectation of life among the Muslims is lower. The lower mean age of Muslim females, Province by Province, is particularly striking.

	Hindu		*Muslim*	
	Males	*Females*	*Males*	*Femal*
Punjab . .	**24·7**	**23·4**	**23·8**	**22·7**
United Provinces .	**24·1**	**24·3**	**23·8**	**23·3**
Bihar and Orissa .	**23·4**	**24·0**	**22·6**	**23·0**
Bengal . .	**Figures not available**			
Assam . .	**23·9**	**22·2**	**22·0**	**20·1**

There is no doubt that polygamy is a factor in over-population. Polygamy is much in evidence among the Muslims in the Punjab in the landlord tracts, and in Bengal in the eastern districts. In the age group 15 to 40, which is the reproductive period, the number of Muslim widowed females per thousand in the United Provinces and Bengal is 102 and 113 as compared with 139 and 210 respectively among the Hindus. For the Punjab the disparity is even greater, the number of widowed Muslim females of the age group 15 to 40 being only 57 as compared with Hindu 92. The subsidiary tables given by Middleton and Jacob in the *Punjab Census Report*, 1921, furnish the only materials on which a reliable estimate of the extent of the practice of polygamy among the Muslims can be derived: 855 cases were recorded for three districts covering ten different Muslim castes. We have worked out the number and percentage of polygamous marriages from these tables.

TABLE SHOWING THE EXTENT OF POLYGAMY AMONG THE PUNJAB AND DELHI MUSLIMS

Description of wives	*Number of wives*	*Proportion of polygamous marriages*
Second Wife	127	14·85
Third Wife	21	2·45
Fourth Wife	5	0·58
Fifth Wife	1	0·11

Most of the second, third or fourth wives among the Muslims are widows who have adopted widow re-marriage throughout India. Thompson in his *Census Report of Bengal*, 1921, has given the only estimate which has been published of the extent to which re-marriage of widows takes place among the Muslims.

NUMBER PER 1,000 MOHAMMEDAN FEMALES IN EACH AGE PERIOD WHO ARE

Age	*Living as widows*	*Living as wives of second husbands*
0–5	1	0
5–15	4	0
10–15	18	10
15–20	41	40
20–25	61	70
25–30	105	115
30–35	196	125
35–40	321	60

In the new clearings and isolated hamlets in Eastern Bengal, the needs of agricultural expansion have fitted exceedingly well with the Muslims' polygamy and widow remarriage, which are both unacceptable for the Hindu peasants. In the hamlets that arise and disappear on the shifting sand dunes of the rivers and are exposed to dangers from storm waves and cyclones, crocodiles and tigers, fevers and brackish waters, cultivation is intermittent and settlement is temporary and precarious. The Mohammedan custom of adopting more than one and as many as four wives, who serve as field labourers in new reclamations, contributes towards the success of agricultural colonisation in virgin wildernesses, islands and swamps where the delta-building rivers meet the sea in Bengal. Amongst the Mohammedan males not merely is the proportion of married much higher than among the Hindus, but the proportion of widows amongst females is much smaller. The following contrast of marital condition of 1,000 of each sex (all ages) in Eastern Bengal is full of significance.

NUMBER PER 1,000 OF EACH SEX

	Hindus		*Mohammedan*	
	Male	*Female*	*Male*	*Female*
Married . .	467	472	507	544
Widowed . .	45	218	18	123
Unmarried . .	488	310	475	333

The proportion of children below 10 years per thousand of each sex is much higher in Bengal, Bihar, the United Provinces and the Punjab amongst the Muslims than the Hindus, showing a larger proportion of births for the Muslims.

		Hindu		*Muslim*	
	Age Group	*Male*	*Female*	*Male*	*Female*
Bengal and the U.P.	0– 5	133	149	161	177
	5–10	124	120	147	141
Bihar and Orissa	0– 5	145	151	153	158
	5–10	138	127	152	137
Punjab	0– 5	137	161	146	169
	5–10	123	129	130	134

These figures indicate that the economic consequences of polygamy and widow remarriage must sooner or later challenge the attention of legislators in India. It is well known that in Turkey the religious sanction of polygamy has been removed and polygamy has been abolished. In Persia also the civil registration of marriages has abolished the ecclesiastical support to polygamy, which is now much less prevalent than a few decades ago.

Both widow remarriage and polygamy thus chiefly account for the more rapid increase in the Mohammedan than the Hindu population so noticeable during the last 50 years in the whole of the Ganges valley, especially in the eastern districts where the Mohammedan increased from 645 to 710 per mille of the total population. Even in areas where there is a general decline of the total population the Mohammedan household has increased in size and filled the gap left by the declining Hindu castes. The Hindus are declining in numbers not only in Western and Central Bengal, where the Mohammedan is fast filling up his gap, but also in Eastern Bengal where the conditions have proved so favourable to the sister community. Fifty years hence out of ten persons in the fields or city lanes in Eastern Bengal eight will be Mohammedans, one will be a Namasudra and another person a Brahman, Vaidya or any other caste. For the whole of Bengal for every one literate caste Hindu there will be six Mohammedans and three backward caste Hindus, a Mahisya, a Namasudra, a Rajbangsi or any other caste. The sudden expansion of social groups which are less cultured, which now obtain less economic and social opportunities and yet which receive special political treatment, does not augur well for smooth economic re-adjustment and harmonious social intercourse in Northern India.

CAUSES OF A LOW SEX RATIO AMONG THE HINDU CASTES: REGIONAL FACTORS

The chief cause of the decline of the upper Hindu classes is a low sex ratio, the effects of which are intensified by caste and marriage restriction. In the Ganges valley as we rise in the Hindu social scale, and the caste is further removed from the thorough-breds of the soil, the paucity of females increases. There are only 776 females per 1,000 males amongst the Jats in the United Provinces. Among the Kayasthas, who are one of the most literate and at the same time most decaying communities in the whole of Northern India, the number of females per 1,000 males is only 835. The Rajputs and the Brahmans show also deficiency of females, the number of females being 866 and 882 respectively per 1,000 males. In the Punjab the Brahman, Khattri and Arora have all a low sex-ratio, viz., 822, 819 and 865 respectively. On the other hand, the prolific Chamars and Pasis do not show such paucity (957) while the Muslim figure is 900. Most of the backward castes do not show any scarcity of females; some show even an excess and all are more fecund than the high castes.

The sex-proportion by selected castes in the Punjab, the United Provinces, Bihar and Bengal, supplies us with interesting clues as to the decay of the more important Hindu communities, amongst whom the racial effects of this extremely small proportion of females at the reproductive ages are aggravated by the various barriers to marriage such as exogamy, endogamy, hypergamy and prohibition of widow remarriage would impose.

NUMBER OF FEMALES PER 1,000 MALES OF ALL AGES

	Indo-Gangetic Plain			*Behar*	*Bengal*
	West	*Central*	*East*		
Upper Hindu Castes :					
Kayastha	802	819	925	921	901
Brahman	789	894	934	964	847
Rajput	780	850	899	905	Not important
Lower Hindu Castes :					
Chamar	882	992	1,049	1,100	Not given
Dom	899	954	940	Not given	965

The effect of the regional factor is obvious. Generally speaking, the sex ratio is greater in the lower than in the higher Hindu castes and higher in the same caste as we advance towards less arid conditions. The same tendency is noticeable among the Muslim castes. The Mohammedan sex ratio tends to increase as we proceed eastwards the Mohammedan being mainly converted from Hinduism.

NUMBER OF FEMALES PER 1,000 MALES OF ALL AGES IN MUSLIM CASTES

	United Provinces	*Bengal*
Sayid	900	888
Julaha	919	916

If we also take into consideration widespread and important castes from each of the three Provinces, which are, however, absent in others, the general tendency of an increase in the sex ratio, as we proceed from west to east, is corroborated.

NUMBER OF FEMALES PER 1,000 MALES OF ALL AGES

United Provinces:	
Jats	776
Gujars	786
Tagas	805
Pasis	957
Ahirs	895
Kurmis	918
Bihar:	
Koeri	967
Teli	993
Santal	1,003
Goala	957
Bengal:	
Bauri	1,017
Mahisya	952
Namasudra	964

We thus find that as we move towards the dry region the same castes show a lower sex ratio. Both in Rajputana and Sind there is great paucity of females. In Sind the average proportion of females to 1,000 males varies between 780 to 787. Several high castes in Western India show a low female index such as Brahman Deshastha 894, Audich 911 and Chitpawan 951; Kayastha Prabhu 863, Ghanchi 861 and Sind Lohana 865.

RACIAL FACTOR IN THE SEX RATIO

Conditions in South India as regards the sex ratio of its population are somewhat different from Northern and Western India. The population of the Madras Presidency, on the whole, contains more women than men, although the general tendency has been towards a decline of the proportion of females. Recorded statistics also show that in regions where the Dravidian-speaking race elements and primitive tribes predominate the proportion of female births is higher than where the Indo-Aryan speaking elements and higher castes prevail. In Travancore most of the primitive tribes and the castes included in Marumakkathayi show an excess of females over males. Similarly in Cochin the Marumakkathayan communities and the indigenous Malayali castes generally show a striking excess of females. It is in Travancore rather than in Cochin or in the Madras Presidency that any correspondence between a high sex ratio and racial elements can be clearly discerned. The Travancore Census Superintendent remarks: "The inference that may be drawn from the figures showing the sex ratios in three groups of castes and tribes is that the highest sex ratio of the primitive tribes is probably due to the race; and the higher ratio among the Marumakkathayis than among the Makkathayis, may be due to their difference in the social customs." It is expected that where the law of inheritance is through females and early marriage is not practised, such causes to which the prevailing deficiency of females in India have been attributed, namely, female infanticide, neglect of female children, premature childbearing, harsh treatment accorded to females, especially widows, and hard work done by them do not operate. A stronger racial admixture of primitive and Dravidian-speaking elements, as well as social custom, which favour the female more than the male, seem to favour a high sex ratio in the population, a condition which is maintained both by endogamy and favoured by the developments of recent times, connected with female education and emancipation and modern midwifery.

NUMBER OF FEMALES PER 1,000 MALES OF ALL AGES

Travancore:	
Primitive	
Ullatan	1,284
Kuravan	1,074
Thantapulayan	1,060
Marumakkathayis	
Nayar	1,014
Ilavan	1,009
Makkathayis	
Brahman other than Malayali	988
Malayali Brahman	858
Cochin:	
Marumakkathayis	
Nayar	1,154
Kshatriya (Malayali)	1,180
Velakkathalavan	1,038
Ambalavasi	1,030
Makkathayis	
Brahman (Tamil)	999
Kudumi (Chetti)	960
Brahman (Malayali)	956
Madras Presidency:	
Paraiyan	1,055
Maravan	1,036
Panchama	1,027
Savara	1,024
Arya Vaisya	973
Brahman Malayalam	860

COMPLEX PROBLEM OF SEX DEFECT IN INDIA

The paucity of females among the upper-class Hindus in India is a biological trait which has some, though inadequately understood, connection with climate, diet, race and social history. It may be due, first, to an age-long process of evolution in which families and stocks which bred more males had higher survival values. Secondly, climatic and dietetic factors may have also some influence on the sex ratio which also becomes lower. According to Myerson, chemical and food-stuffs have an enormous influence on sex ratio and fertility in the animals. In Northern India as we proceed from

East to West, arid conditions increase and sex ratio again becomes lower. Thirdly, regional conditions affecting mortality throw a more adequate light on sex ratio. In the plague regions of India the malady appears to bear more severely on females than on males. Similarly, in malaria-haunted zones, malaria appears to exercise a selective lethal influence on women. On the whole, where economic pressure is more severe and the woman more exposed to the hardships of struggle with the soil and climate, as in the zones of precarious rainfall, there is a striking and permanent paucity of women. "It is possibly significant," observes the Census Superintendent of Madras, "that it is the area in Madras Presidency where life is in some ways hardest that yields a continuing deficiency of women. The Deccan districts are the Presidency's famine zone where climate is most uncertain. The extensions of the deficiency belt are generally among hills where soil is poor and conditions difficult." It is possible that with greater accuracy of vital statistics, we shall be much nearer to understanding the problem of sex defect in India. Finally, deliberate or unconscious neglect of girl-babies is also responsible to some extent for an insufficiency of females while a large maternal mortality also explains the low sex ratio in later life in particular castes. We read in the *Census Report* of 1911: "There is the deliberate neglect with the object of causing death, which is practically infanticide in a more cruel form; and there is the half-conscious neglect, due partly to habit and partly to the parents' great solicitude for their sons. The boys are better clad and when ill are more carefully attended." Deliberate or unconscious neglect of female babies is also true of

China, where the number of females is only 44 per cent of the population as compared with India's 48. It is thus that the social attitudes of the people profoundly disturb the proportion of sexes.

It is accordingly necessary to examine the sex composition of the castes through the age-groups and study its habitat, racial history, occupations and social usages. In many castes fewer females are actually born than males. The tendency to neglect female children, which causes a higher mortality amongst females than amongst males, is more powerful in certain castes and communities than in others. Again, female mortality, especially in the later stages of the child-bearing period, is heavy in all castes, but heavier in particular classes of the population. In some castes again social habits and dietaries contribute towards a less heavy mortality of widows as compared with married women. We can therefore properly understand the female sex ratio and its effects upon the trend of population when we survey intensively both birth and death statistics and the sex composition of different castes and communities in the different age groups.

DYSGENIC MARITAL REGULATIONS

But social customs and usages have aggravated the natural danger from a low sex ratio. As we proceed from Bengal towards the west the social regulations which limit the circle within which a person must marry, those which expand the circle within which the person must not marry, and a third set of regulations which prevent widow re-marriage, become more and more rigid and inconvenient.

Hypergamy adds further to the difficulties of the social situation by restricting the marriage group and establishing the custom of dowry among all castes of good social standing, the Brahmans, Rajputs, Vaishyas and Kayasthas in particular. The custom of marriage dowry is responsible for a considerable amount of agricultural indebtedness, for the neglect of girl infants, postponement of marriage and even other evils, and is a most glaring example of a false biological evaluation in castes which have a low sex ratio.

The net result is that in the United Provinces 450 to 475 per 1,000 females are married, and about one-fifth of the females in a Upper Hindu caste do not bear children. The number of widows per 1,000 females is as high as 216, 218 and 182 respectively among such castes as Brahmans, Rajputs and Kayasthas. Amongst the Mohammedans, Pasis and Chamars the number is only 123, 128 and 136 respectively.

MARITAL CONDITION OF 1,000 FEMALES (ALL AGES) OF SOME OF THE UPPER AND LOWER-CASTE HINDUS AND MOHAMMEDANS IN THE UNITED PROVINCES

Hindus:		*Married*	*Unmarried*	*Widowed*
Upper Class	Brahman	473	311	216
	Rajput	492	319	189
	Kayastha	448	370	182
	Kurmi	576	254	170
Lower Class	Chamar	563	301	136
	Ahir	559	293	148
	Pasi	568	304	128
Mohammedans		529	348	123

The large proportion of widows among the higher castes, the postponement of marriage or the disparity of the ages of the married couple due to the increase of the bride-price among many castes, high or low, on account of economic stress, coupled with infant marriage, which means more widows—all these factors foretell racial suicide.

Among the upper castes the paucity of females is increasing from decade to decade throughout Northern India and yet endogamy which perpetuates this trait is being maintained. Endogamy, hypergamy and internal differentiations, and special grading of castes and groups, might have been necessary amid a welter of diversity of folks and cultures in the Upper Ganges region which lay on the high road of migration of peoples from the north-west. But at present these practices have become dysgenic.

INVERSE CORRESPONDENCE BETWEEN SURVIVAL VALUE AND FECUNDITY AND LITERACY

The age-distribution of important castes and social groups in Northern India indicates that the backward sections are more progressive demologically than the rest of the population, but that:

(*a*) They are less long-lived than the others.

(*b*) The adult group is the most predominant amongst the advanced castes and communities in which the aged also bulk most largely; and finally:

(*c*) The general increase of population is more in evidence among the more fertile but less intellectual strata of society.

NUMBER OF MALES PER MILLE AGED

	0–6	7–13	14–16	17–23	24–43	44 *and over*
A.—Advanced Castes						
I. United Provinces						
	Age		*Age*			
Brahman	320 (0–13)		488 (14–23)			192
Kayastha	350 (0–13)		503 (14–43)			192
II. Bihar						
Brahmin	159	165	68	121	306	181
Kayastha	164	168	65	116	295	192
III. Bengal						
Brahman	163	156	68	143	308	162
Kayastha	172	166	70	135	289	168
Baidya	173	172	85	141	261	168
B.—Intermediate Castes						
I. United Provinces						
	Age		*Age*			
Rajput	322 (0–13)		493 (14–43)			185
Kurmi	340 (0–13)		495 (14–43)			165
II. Bihar						
Rajput	159	169	64	115	309	184
III. Bengal						
Mahisya	174	169	69	132	301	155
C.—Illiterate Castes, including Muslims						
I. United Provinces						
	Age		*Age*			
Chamar	381 (0–13)		480 (14–43)			139
Ahir	360 (0–13)		482 (14–43)			155
Pasi	384 (0–13)		473 (14–43)			143
Jolaha	387 (0–13)		455 (14–43)			158
II. Bihar						
Goala (Hindu)	189	186	62	102	303	158
Santal	218	190	70	115	290	117
Musahar	215	193	61	92	291	148
III. Bengal						
Namasudra	180	177	65	126	286	166
Dom	168	159	60	117	344	152
Jaliya Kaibarta	183	160	71	125	293	168
Jolaha	192	188	61	118	304	137

It will be seen that the percentage of children among the advanced and intermediate castes is strikingly low in Bihar and Bengal, but the percentage increases steadily as we proceed downward in the scale of caste and literacy, until the figures for the illiterate castes are very high. Secondly, as we descend the scale of caste and literacy, the proportion of the adult population diminishes. The last two columns show clearly how much lower the survival value is in the case of the illiterate castes. The survival value increases as we ascend the social scale, being the greatest in the case of the United Provinces and Bihar Kayastha. It is notably low in the cases of the Santal of Bihar, the Pasi, Chamar and Jolaha of the United Provinces and the Dom and Jolaha of Bengal. The Muslims in Bihar and Bengal are more numerous in the early age periods, and their survival value diminishes as we proceed from the west to the east and is the same as that of the intermediate Hindu castes of the United Provinces, and also approximates to that of the Hindu illiterate castes in Bihar and Bengal.

An eugenic programme will include inter-caste marriage, affording a basis for a better selection, widow re-marriage and the abolition of hypergamy, dowry and bride purchase, as well as of regional, sectional and other barriers to intermarriage among the upper Hindu castes. In agriculture the long accustomed aversion of the upper-caste Hindus to manual labour and their dwindling strength have become serious handicaps. In the economics of the fields the Rajputs of the United Provinces, for instance, have in recent years lost a considerable area of land, while the Lodhs, Muraos, Chamars and Pasis have all gained considerably, as they certainly deserve to gain, in spite of certain differential treatment meted out to them by the upper-class Hindu landlords and moneylenders. Not only the

Rajputs but the Brahmans, the Kayasthas and other high castes who own good landed property but disdain to drive the plough are going down in face of the unequal economic competition of lower agricultural castes who are proving superior in land utilisation and whose very numbers will in future add to their economic and political advantage. Thus the social attitudes as regards manual toil aggravate the effects of dysgenic customs and practices in bringing about a gradual predominance of the inferior social strata.

INDEX

Abortion, early practice of, 217, 218
—, still prevalent in India, xiii
— in drinking women, 185
Absenteeism due to sickness, statistics relating to, in jute mills in Bengal, 175
Achar, or social obligation of service, 211
Acreage needed by vegetable and animal foodstuffs respectively, to produce a given number of calories, 124
Adulteration, depriving foods of real food value, 159
Age-categories, Sündbarg's, 12, 13
— of Consent Committee, 214
— — —, findings of, 45
— — — on early deaths of girls married at 12 years of age, 215
— -periods specially affected by chronic food shortage, 44
— —, certain, variations of population at, in United Provinces of Bihar and Orissa and Bengal, 43
Agra District, United Provinces, relation between harvests and vital statistics in, 49
Agricultural adaptation to population pressure, 85 *et seq.*
— depression in India, 20
— —, lowering effects on Indian farming population, 190
— industries, development of, 208
— industry, largest percentage of contribution to national income of India, 28
— labourers, why large numbers are needed in India, 196
— prices in India, rise and then fall of, 198
— production in India and increase of population, disparity between, 197
— — in India, disparity between value of and increase of population, table illustrating, 199
— — in India, rate of growth in excess of rate of growth of population, 20
Agricultural workers in the Punjab, diet of, 62
Agriculture, dependence of Indian population on, 205
—, exclusive dependence on, accompanied by saturation point for local food-supply, 6
— in India, over-crowding of, means of mitigating, xiii
—, means of supplementing, 209
—, neglect of, by Hindu upper-class castes, 239, 240
—, over-crowding in, 34
— — —, how to relieve, 194
Agriculturist's family, mineral deficiency in diets of, 79
Ahimsa, cult of evil effects of, 153
Akbar, estimate of population of India at death of (1605), 3
Alfalfa leaf, 125
Alkali, pulses containing, 165
Allahabad, fruit growing near, 108
Amino-acids in legumes, dietetic value of, 96
Anaemia, regions in which more prevalent in India, 162
Ancients, the, comprehension of relation between food supply and mortality of population, 1
Animal and vegetable foodstuffs, acreage required by respectively, to produce a given number of calories, 124
— — — products, relative importance in Punjab diets, tabulated, 123, 124, 125
— husbandry and crop production, link between, 152
—, origin, foods of, factor excluding them from consumption in India, 123
— products, practical absence of in Indian peasant dietary, 187
— —, reason for not being favoured in Eastern countries not exclusively religious, 125
— proteins, co-efficient of digestibility, 72

Animal proteins, poor in quantity in diet of, non-vegetarian classes, 65

Animals, smaller, consuming more food than larger, weight for weight, 139

Antia and Kale, on standard of calories fixed by for agriculturists of Baroda, 60

Arable land, deterioration of, how caused, 143

Arhar, 105

Arm-chest-hip index of nutrition, 162

Artificial substitution, depriving foods of real food value, 159

Asia, half the human race contained in, 2

Assam, under-populated, 203

Australia, increase of expectation of life in, 50

Aus rice, renewed cultivation in Eastern Bengal, 90

Avitaminosis B, pregnant females in state of, in Southern India, 162

Aykroyd, diseases prevalent in Southern India, 163

—, ill-effects of deficiency of calcium in diet, 165

—, standard of protein requirement per adult in India (footnote), 72

—, Vitamin A deficiency among children in Southern India, 162

Bags, substitutes for jute in making, 120

Bajra, 89

—, crop and food of poorer classes in India, 87

—, increased production of in India, 21

—, mixed with other foods, dietetic value of, 98

Banana, cultivation of, 109

Bankura, famine diets in, tabulated, 155

— district, deficiency diseases in, 156, 157

— —, spread of leprosy in, 157

Barley, crop and food of poorer classes in India, 87

—, export from India, reason why not desirable, 87

—, increased production of in India, 21

—, wheat grown with, in small holdings, 64

Baroda, agriculturists of, standard of calories fixed for, 60

Baroda, distribution of fertility rate in, 54

—, yield of crops in, below standard (1921-1930), 193

Basal metabolic rates of Indians, lower, reason for, 71

— metabolism, factors influencing, 60, 61

— —, important governing factor in, 168

— — in various parts of India below Western standards, 60

— — lower in tropical or sub-tropical regions, 59

— —, measurement of in determining hours of labour in factories, 84

Basu and Basak, biological values of proteins of certain crops in India, 67

Bean, *see* Saga bean

Beans, expansion of crops of, 101

Behm, estimate of population, 3

Bejhar, consumption of, 64

—, mixtures composing, 64

Belgium, mixed farming in, 147

Benares, fruit growing near, 108

Benedict Metabolism Apparatus, 59

Bengal, absence of grazing facilities in some over-stocked districts, 140

—, appetite of inhabitants compared with that of dwellers in Northern India, 71

—, average mining output per individual worker over a number of years compared with that in other countries, 173

—, birth-rate in, fall of, 41

—, coal mining labour in, compared with that of Europe, 173

—, contrasts in diet and physique of workers, 172

—, death-rate in, reduction of, 48

—, decline of oil-seed crops in, 91

—, decrease of industrial employment in, 207

—, — of industrial employment in, details tabulated, 207

—, deficiencies of diet in, 164

—, diet of natives and immigrant workers contrasted, 171

—, diseases due to faulty diet found in, 162

—, effect of climate on diet in, 71

—, emigration from explained, 202

—, food standard for, 73

—, jails of, high incidence of dysentery in, 163

Bengal, jute mills in, statistics of absenteeism due to sickness in, 175

—, lower metabolism in, 85

—, malaria in, annual mortality, 38

—, — prevalence in, 13, 38, 175

—, paucity of fodder crops in, 140

—, percentage increase of area and of output of paddy, tapioca and cocoanut in, 90

—, population generally short-lived, 13

— —, great increase of, 3

— —, variation of at certain age-periods, 43

—, poverty in, how indicated by diet, 106

—, prevalence of calculus in, 162

—, rice-production in, deficit per annum, 22

—, spread of epidemic beri-beri in, 161

—, staple foods of native and immigrant labourers in, tabulated, 171

—, undersized holdings in, 193

—, unparalleled increase and deterioration of cattle in, 139

—, water-logged wastes in, formation of, 12

—, Eastern, catch crops maintaining dense population in, 89

—, —, crop rotation in, how upset, 90

—, —, crops maintaining a dense population in, 89

—, —, density of population to the square mile in various divisions and sub-divisions of, 3, 4

—, —, marital condition of 1,000 of each sex (all ages) in, 227

—, —, Muslims, converts from lower-class Hindus in, 222

—, —, successive crops of rice in, 94

—, Northern and Eastern, rotation of crops in, 95

—, Western, analysis of food values of diets collected in, 155

—, —, decline of *rabi* cropping in, 91

—, —, scarcity areas, investigation of, 154

Bengalee, average protein intake and body measurements, 173

Bengalees, inferior physique of, factors governing, 170

—, lower percentage of metabolism of, 59

Bengali and Scotch weavers in spinning industry, figures of output compared, 173, 174

—, children, high incidence of rickets in, 162

Beri-beri, 162

—, cause of, 160

— epidemic, spread in Bengal, 161

—, how counteracted, 162

—, prevalence in Japan, 160

Bhadralok classes, 202

Bhattarjee, N. C., alkali content of pulses (quoted), 105

Bihar, birth-rate in, fall of, 41

— , death-rate in, reduction of, 48

—, undersized holdings in, 193

—, North, foundation of water-logged wastes in, 12

—, —, successive crops of rice in, 94

—, — and South, increase in population of, 3

— and Orissa, decrease in numbers of industrial workers in, 206

— —, emigrants from, reduction in numbers of, 202

— —, emigration from explained, 202

— —, fertility rate of, 52

— — Government, introduction of outstill auction system by, 184

— —, rice-production in, deficit per annum, 22

— —, variations in population at certain age-periods in, 43

Birbhum, spread of leprosy in, 157

Birth-control, adoption in higher social circles of India, 218

—, advantages of to masses of Indian population, xiv

—, appropriate and cheap devices of, why necessary, 215

— clinics, conversion of child-welfare centres into, xiv

— propaganda, need of, 216, 217

—, safety and sureness of, 217

—, spread of in India, how hindered, xiii

Birth-rate, fall of in United Provinces, Bihar and Bengal, 41

—, high, followed by high mortality, 40

— in India, decline in, causes of, 47

— — —, factors lowering, 42

— — —, respective expansion and diminution of, how caused, viii

—, slackening of in plains of India, cause of, 46

Births, frequency of at short intervals, disastrous effects of, 45
—, larger proportion among Muslims, how shown, 227
—, premature, incidence in Southern and Northern India compared, 162
Blindness in calves, how caused, 139
— in Madras Presidency, commonest cause of, 165
Body-calcium, loss of, effects on cattle, 138
— measurements of Bengalee, 173
— -weight, food-requirements in relation to, 55
Bombay City, population of, declining, 206
— Presidency, decline of industrial expansion in, 206
— —, distribution of fertility rate in, 54
Bovine population of India, enormous, cannot be added to, 153
— — —, increase in millions in two decades, 142
Brahmin farmers, mineral deficiency in diets of family of, 79
Brahmins, percentage of decrease, 223
British agriculture, superiority of German agriculture over, explained, 128
— Army, minimum chest measurements for ordinary line regiments of, 173
— diets, basis of analysis of, 73
— Empire should treat Indian emigration as an Imperial problem, 203
— working man and Indian working man, diets and caloric values of diets compared, 82, 83
Buck, *Chinese Farm Economy*, quoted, 94, 95
—, estimate of best family-sized farm in China, 6
—, on Chinese dietaries, 125
—, scarcity of cattle in China, 195
Buffaloes, advantages of keeping, 146
Bullocks, demand for, regulating number of cattle within a district, 133
—, number employed in cultivating 100 acres of land, 135
—, superfluous, 135
—, uncastrated, castration of urgent, 151
Bulls, covering at choice by, 145
Bulls, *see also* Scrub bulls.
Burdwan, famine diets in, tabulated, 156.
—, number, and kinds of cattle in, 148
—, phenomenal increase of livestock in, 140, 141
Burma, amount of rice produced by, 22
— under-populated, 203
Burridge, caloric energy of peasant's diet in United Provinces, 58
Butter preferable to *ghee*, 99

Calcium, deficiency in diets of family of Brahmin farmers, 79
—, important sources of in Indian dietary, 74
—, sources of, in Indian dietary, 74
— and protein deficiency in Indian diets, 82
—. *see also* Body Calcium
Calculus (stone) prevalence in Bengal and Madras, 162
—, suggested cause of, 162
Calcutta, milk and milk products expensive in, 158
Caloric energy of peasants, diet in United Provinces, 58
— requirements in India, 57-60
— value of various articles of food-supply of India, estimated, 24
Calories, abundant supply yielded by *menu* of Jat cultivators of Lyallpur, 165
—, acreage required respectively by animal and vegetable foodstuffs to produce a given number of, 124
—, amount yielded by carbohydrates, 72
—, expenditure of, threefold increase of, how effected, 83
—, number needed by peasants of United Provinces, 59
—, one thousand, amount of land required to produce, in the form of milk and cereals compared, 124
— per unit yielded by dietary of Central Provinces immigrant worker, 171, 172
— required for moderate work and for heavy work respectively, 83
—, total requirement for population of India, 23, 24
— and food-materials, distribution of quantities of in peasant and working-class diets in India, 78, 79

Calorimetric value of food, reduction of, shown in certain European countries, 125
Calves, blindness in, how caused, 139
Cambu, nutritive quality of, 86
Carbohydrate, wheat a source of, 68
Carbohydrates, calories yielded by, 72
— in peasant's diets of Northern India, 65
—, reduction of in diet, 98, 99
— and fats replacing each other, 72
Cash crops, right combination of, 89
Castes, advanced, intermediate and illiterate (including Muslims), number of males per mille, 238
—, composition of, 235. *See also* Hindu Castes
Castration of scrub bulls and uncastrated bullocks urgent, 150, 151
Cattle-breeding, facility for, in the Punjab, 144
—, chronic starvation of, 135, 136
— Crisis Act, passed in the Netherlands, 151
— — in India, planned programme for overcoming, 150 *et seq*
— — —, real remedy for, 153
— density and crop area *per capita*, inverse correspondence between, 130
—, deterioration of, 141
— feeding, requirements of, in India, 128
— in different parts of India, contrasts between, 131
— in India, increase in, number of, x
— — —, reduction of number, urgent, 151
— — —, uneconomical and useless maintenance of, xi
—, largest numbers of, maintained in Provinces with smallest crop area, *per capita*, 130
—, malnutrition among, effects of, 138
—, multiplication in India to counteract inefficiency, 133
— — —, upon what dependent, 133
—, number kept in India compared with those maintained in other countries, 132
— population, excessive numbers of, in India, 195
— — in Silapur district, Oudh, 134, 135
Cattle, sale or slaughter of, religious objections to, 144
—, smallness of number in Japan, 131
—, superfluous, of India, 131
—, unparalleled increase and deterioration in Bengal, 139
Cawnpore, approximate percentage of factory population in, 176
—, average mortality in each of labour quarters (1921–1928), 176
—, mortality from tuberculosis in, 177
—, overcrowding in, 177
—, percentage of expenditure of working-class families in, 181
—, staple foods of workers in, 63, 64
—, workers, daily per head consumption of food compared with standardised United Provinces jail diet, 65
—, working-class families, monthly expenditure on miscellaneous items, 182
Census Report (1911) on infanticide through neglect, 234
Central Provinces, contrasts in diet and physique of workers, 172
— — Government Report on standard of living of working-class families, 181
— —, immigrant worker, calories per unit yielded by dietary of, 171, 172
— — — —, diet of, 171
— —, slight diminution of industrial workers in, 206
— —, under-populated, 203
Cereals, amount of land required to produce 1,000 calories in the form of, 124
—, chief, fall in prices of, 198
—, co-efficient of digestibility, 72
—, decline in use of, in United States, 86
—, differences in nutritive qualities of, 86
—, food value of, 33
—, increases in production, yields per acre, calories and proteins available, compared, 87
—, inferior, great increase in production in India, 87
—, less nutritive, relative expansion of in India, 20
—, nutritive, and protein value compared, 68
—, relative value of in India, 67

Cereals, replacement in Europe by dry farinaceous vegetables, 103
— and other foods of Northern India, average percentage composition, 67
— and pulses, variety of consumed in different parts of India by workers and peasants, 69
Chapattis, 102
—, components of, 64
—, wheat, 62
Child-birth, death-rate of girl-wives at in India, 45
—, maternal mortality at, in India, 45
— marriage, introduction of, 213
— -welfare centres, conversion into birth-control clinics, xiv
Children at birth, insanitary surroundings of, 219
— below ten years per thousand of each sex, provinces in which proportion is higher amongst Muslims than Hindus, 227, 228
—, deficiency diseases among, in coalfield districts, 185
—, food requirements of, coefficients of comparison with those of average man or woman (Lusk), 23
—, foraging for fruits by, 77
— in Southern India, Vitamin A deficiency among, 162
—, institutions for, in Calcutta, defective diet in, 159
—, malnutrition in, effects of, 43
—, number under ten years per 100 married females, 53
— and adults, proportion to total population of India, 23
China, 89
China, animals kept for food in, 63
—, best family-sized farms in, Buck's estimate, 6
—, cattle population of India compared with that of, 195
— — —, scarcity, 195
—, consumption of meat in, 63
—, dietetic uses of soya bean in, 104
—, effect of climate on diet in, 71
—, export of soya beans from, 114
—, importer of, though leading producer of rice, 28
—, neglect of female babies in, 234, 235
—, no dairy industry in, 63
—, peasantry in, sources of food energy for, 126, 127
China, protein standard adopted in (footnote), 71
—, reason for non-existence of animal raising in, 153
—, reduced animal population of, 130
—, silk industry in, 122
—, use of human excrement as manure in, 195
—, wheat yields in, compared with those in India, 194
—, East Central, rotation of crops in, 95
—, North, rotation of crops in, 95
— and India, difference between, as regards consumption of animal foods, 62, 63
— — —, cropping conditions in, contrasted, 94, 95
—, India, Japan and United States, crop yields per acre in quintals of wheat and rice, compared, 190
— — and the world, crop yields for all crops, tabulated, 190, 191
Chinese, average weight of, 55
Chittenden, calorie requirements, 57
—, figures of nitrogen metabolised per kilogram of body-weight compared with those of other workers, 57
Cholera in India, mortality from, 37, 38
Climate in relation to sex ratio, 233, 234
—, reduction of age of puberty by, 214
Climates colder, greater amount of nitrogenous foods taken by those in, 56
—, warmest, successful dietaries evolved in, 169
Climatic factor in relation to strong physique of Punjabis, 168
Clothing needs less in India, 179
Coal mining labour in Bengal compared with that of Europe, 173
Cochin, castes in, showing an excess of females over males, 232, 233
Coconut, percentage increase of area and of output in Bengal, 90
Coimbatore, thick sugar-cane grown at, 110
Commodity prices in India, rise in, from 1917 to 1930, 197, 198
Contraception, advantages and benefits arising from, 218, 219
—, application during early years of marriage, 215

Contraception, crude, observed among Goudans of Salem, 218
Coonor, diseases to which ill-fed cattle at, are subject, 138
Corn, acreage and yield in India and other countries compared, 128
Cotton, cultivation of in India, decreasing, 121
Country liquor, source of Vitamin C, 75
Cow, reverence for in India, evil results of, 153
— -buffaloes more productive of milk, 135
— -keeping and fodder-cultivation, conditions contrasted in two districts, 133
Cow, non-calving of, 139
—, unproductive, 135
Crop adjustment to high density of population in India, 89
— production and animal husbandry, link between, 152
— — and regeneration of soil fertility, balance between, how upset, 195
— —, volume of, in India, index numbers of population and, 17
— yield *per capita* of great importance in India, 197
— — and man-power, relation between, 196
— yields in India high under hand cultivation, 128
— — —, improvement in, points to be considered in relation to, 197
— — —, methods of improving, 128
Crops to be substituted in place of diminishing wheat, 101
—, rotation of, in China and India compared, 95
Cropped areas and output of food grains in India, 30, 31
Cropping, changes in India, circumstances controlling, 89
—, — in population, pressure in relation to, 86
—, inferior, in India, 88
Croppings, curtailment of, 193
Cuba, sugar production to the acre in India compared with that of, 111
Cultivated area in India, index numbers of population and, 17
Cultivation, costs of, how raised, 34
—, expansion of, obstacles to, 10, 11
Cultivators, effects of malnutrition upon, viii, ix
Culture and fecundity, disparity between, greatest in Northern India, 221
Dairying, systematic where impossible to adopt, in India, 150
— and mixed farming, districts of India where carried out, xi
Dairy animals, better feeding of in Punjab, 143
— industries absent in China, 63
— products, supply of, inadequate in India, x
Dal, source of protein, 62
Dals, not easily assimilable, 99
—, protein content of, 102
—, suggested improvement in use of, 99
Darling, action of midwife in rendering women incapable of bearing any more children, 218
—, facility for cattle-breeding in the Punjab, 144
Death-rate, reduction in Bengal, 48
— —, — in United Provinces and Bihar, 48
— -rates in India and other countries compared (1933–1934), 188, 189
Deaths of young girls within ten years of consummation of marriage, 215
Deficiency diseases, 154
— — caused by inadequate intake of proteins, 158
— — in Bankura district, 156, 157
— — in regions affected by scarcity, 154
Deforestation, bad effect on housing conditions, 179
—, no longer possible, 10
De-industrialisation in India, xii
— — —, progress of, 204
Delhi and Punjab Muslims, extent of polygamy among, table showing, 226
Department of Economics and Sociology, Lucknow, proportion of income of peasants and workers spent on education, 183, 184
Development, retardation of, due to under-nutrition, 164
Dhanbad Medical Officer on caution of venereal disease, 185
Diabetes, cause of, 158
Diarrhoea, 162
Diet, defective in children's institutions in Calcutta, 159
— deficiency, evil effects on population of India, viii
—, faulty, diseases due to, found in Bengal and Madras, 162

Diet in relation to industrial inefficiency, 82
—, unsuitable, malnutrition, due to, in Indian villages, 42
Diets, Indian, least satisfactory, 164
— of Bengal and Southern India, deficiencies of, 164
— of peasant and working classes in India, collection and examination of, viii
—. *See also* Famine diets; Peasant and working-class diets.
Dietaries, large variety of, cause, 85, 86
— of workers in various Provinces of India contrasted, 171
—, successful, evolved in warmest climates, 169
—, value of, decline in physique of Indian peoples in relation to, 167.
Dietary, Indian, lines of improvement in, 97, 98
— of Indian peasants, defects of, 187
Dieteri, estimate of population of India, 3
Dietetic value of amino-acids in legumes, 96
Diminishing Returns, Malthusian Law of, 7, 9, 11
Disease, predisposition to, accompanying low metabolic rate, 61
Double-cropped areas, curtailment of, 9
— — —, diminution of, 8, 9
Dravidian-speaking race elements, more female births than male prevailing among, 231, 232
Drink, abortions following, 185
—, expenditure on by working classes, 184
—, Muslims now addicted to, 185
Dropsy, epidemic, 162
Drought diets, food values of, 154, 155
— years, recurrence in Northern India, 23
Droughts, periodical recurrence in India, 21
Drunkenness, increase of, 184, 185
Dual purpose cattle, 145, 146
Dysentery, 162
—, cause of, 158
—, high incidence in jails of Bengal, 163
—, low-incidence in Punjab, 163
Dysgenic marital regulations, 235
— trends of population, 221
Dysgenic trends of population, eugenic programme for 239, 240

East, the, significance of over-population now recognised in, 2
Eastern countries, reason for animal products not being favoured in, not exclusively religious, 125
Economic life, Indian, diversification of, 208, 209
Economists, optimistic views of some and pessimistic views of others controverted, 207, 208
Education, expenditure on by workers and peasants, 182, 183, 184
Electricity, industrial, demand for, 210
Emigrants from Bihar and Orissa, reduction in numbers, 202
— from United Provinces, decline in numbers, 201
Emigration from the United Provinces (1921), tabulated, 201
Endogamy, 230
Engel's law, kind of expenditure following, 181
England, infant mortality rate in India compared with that in, 44, 45
— and India, average expectation of male lives in, 50
—, India, United Provinces and Bengal, comparative expectation of life at birth for males and females (1881–1931), 48, 50
Eugenic programme for dysgenic trends of population, 239, 240
Europe, dry, farinaceous vegetables replacing cereals in, 103
—, Central, evidence of success of animal industry in, 148
— and India, comparison of mining and textile labour in, 173
European countries, reduction in calorimetric value of food shown in, 125
— War, fear of over-population arising since, 2
Europeans and Indians, food consumption of compared, 56, 57
Excrement, human, use of as manure in China, 195
Exogamy, 230
Expectation of Life, comparative for males and females at birth in India, Bengal, United Provinces and England, 48

Export duty on oil-seeds and oil-cakes, 118
Eyes, destruction of, resulting from Vitamin A deficiency, 165

Factories, distribution of rest pauses between intervals of work in, 84
—, Indian, reduction of daily hours of labour in, 205
Factory hours, regulation according to metabolic rate of workers through the seasons, 61
— population, approximate percentage in Cawnpore, 176
— work, pressure in, results of, 83
Family holding, minimum subsistence in India, 4
— limitation in the Punjab, purpose of, 218
Famine camps, 155
— Commissioners, Report of, findings of as regards mortality, 36
— diets collected in Bengal, first laboratory analysis of, viii
— — in Bankura and Burdwan, tabulated, 155, 156
— foods, 154, 155
Famines, diseases accompanying, 36
— in India, mortality from, 35
— — —, recurrence, with sunspot minima and maxima, 36
—, movement of population during and after, 37
—, periodical recurrence in India, 21
Faridpur, agriculture of, Colonel Gastrel's report on, 90
Farinaceous vegetables, dry, replacing cereals in Europe, 103
Farm, best family-sized in China, Buck's estimate, 16
Farmers, Brahmin, mineral deficiency in diets of family of, 79
Farming, mixed, adoption of, 151, 152
— — and dairying, districts of India, where carried out, xi
— —, districts where impossible, 149
Fat, articles of diet supplying, 105
— in Indian diet, need for, 100
—, percentage of, calories to be provided by in India, 72
Fats, animal, replaced or supplemented by vegetable oils in diet, 103
— and carbohydrates replacing each other, 72
Fecundity and culture, disparity between, greatest in Northern India, 221
—, literacy and survival value, inverse correspondence between, 237, 239
Feeding requirements of cattle in India, 128
— standards of livestock in India, 129
Female babies and children, mortality of due to neglect, 234, 235
— infants, neglect of in China, 234, 235
Females, death-rate among from tuberculosis at Cawnpore, 177
—, deficiency of in India, 215
—, disadvantages attaching to survival of, 46
—, greater number generally, than males in Madras Presidency, 231, 232
—, higher death-rates among, than among males in India, 215
—, longevity of, decrease in, in India, 50, 51
—, married, increase, in provinces of India, 13
—, number per 1,000 males of all ages in Muslim castes, 230
— — — — — — in upper and lower Hindu castes, 230
—, paucity of, in India, geographical distribution, 229
—, proportion of to males in India, 51
— — — — — diminution in India, 46
Fertility, adaptive, 219
—, human, restraints upon, benefits accruing from, 220
—, — restraints upon, need for, 219
— rate in India, factors determining, 54
— — in different provinces of India, 51, 52, 53, 54
— — in Scotland, 54
Fevers in British India, mortality from (1922-1931), 37
Fibre production and manufacture, 120
Field labourers, wives of Muslims serving as, 227
Fish, consumption of, increase in Japan, 99
—, containing Vitamin A, 74
— diet consumed by non-vegetarian classes, 65

Fish, supply of, in India, caloric yield, 24
— — —, how increased, 99
Fisheries, conservation of, important, 99
— — and development, neglected in India, 100
Fishing, regulation by law urgent, 100
Flow irrigation, difficulties in way of, 11
Fodder cropping, improvement in, urgent, 151, 152
— -crops, growing of, in India, important and urgent, xi
— —, paucity of, in Bengal, 140
— —, treatment with organic manures, 106
— -cultivation and cow-keeping, conditions contrasted in two districts, 133
—-grass, diminution in dry weather, 136
—, provision by the farm essential, 131
— shortage becoming a famine, 129
— —, chronic, ill effects on breed of cattle, 142
Food, calorimetric value of, reduction in shown in certain European countries, 125
—, larger quantity consumed by smaller animals, 139
— consumption, in Europeans and Indians, compared, 56, 57
— cropping and industrial cropping, combination of, important, xii
— deficiency, how to be mitigated, 107
— elements and calories available per rupee, table showing, 70
— —, essential deprivation of, ill effects on reproductive powers, 46, 47
— energy, consumed by Indian peasant family, how derived, 126
— —, sources of, for peasantry, in India, China and United States, 126, 127
— grains, cropped areas and output of, in India, 30, 31
— —, effects of irrigation upon, 107
— —, number of acres growing in India, 129
— —, treatment with organic manures, 106
— habits, Indian, inelasticity of, 157, 158
Food intake and food requirements in provinces of India, diagrams indicating, 80, 81
— materials, how determined throughout India, 85
— — and calories, distribution of quantities of in peasant and working-class diets in India, 78, 79
— position of India, deterioration, 18, 21
— — —, weakness of, how illustrated, 88
— preparation inappropriate, 159
— production, available food-supply and population, movement of, index numbers of, 19
— — in India, relative expansion of, 20
— products, accessory, need for, 107
— requirements in relation to body-weight, 55
— shortages, chronic, age-periods specially affected by, 44
— — in India, estimate of, 23–26
— — increasing, need for limitation of families under, 219
— standard, theoretical, for India, 73
— standards and food values, 55 *et seq.*
— —, theoretical, in India, 71, 72, 73
— storage, improvement in, desirable, 100
Foodstuffs arranged in order of relative richness in nutrients, 70
—, Indian, vitamins in, 74
— — — —, tabulated, 75, 76
— -supply and mortality of population, ancients' comprehension of relation between, 1
— — available for consumption in India (1931), 24
— —, local, saturation point accompanying exclusive dependence on agriculture, 6
— —, total amount available in India, 30, 31, 32
— — and population in India, variation of, index numbers, 18
— —, trends of population in relation to, 15
— value of cereals, 33
Values in India, analysis of, 66
Fruit and vegetable diet, greater dependence on, important, 100
— growing in India, 108

Fruit industry, development on modern lines, important, 109
Fruits, foraging for by children, 77
— rich in Vitamin C, 75
—, Vitamin C contents in, tabulated, 169
—, Indian, Vitamin C contents in tabulated, 76, 77
Fuel, scarcity of, in India leading to burning of manure, 195
Furniture of working class families, 181

Ganges Valley, districts of, coefficients of over-population, 7
Garden-produce of India, calorie value of, 25
Gastrel, Col., report on agriculture of Faridpur, 90
Gastric ulcer, *see* Stomach ulcer of,
Generation, organs of, affected by under-nutrition, 164
German agriculture, superiority over British explained, 128
Germans, excess percentage of calories and protein in diet of, during the last war, 58
Germany, expectation of life for men at birth, 50
—, mixed farming in, 147, 148
—, oil-seed and nut-crushing industry of, 148
—, Great Britain and India, relation between cultivated area and population compared, 127
Ghee, 149, 150, 158
—, article of diet among North Indian agriculturists, 62
—, boiled, loss of Vitamin A in, 163
—, butter preferable to, 99
—, consumption in summer during agricultural work, 79
—, disappearing in diets of those with smaller incomes, 64
—, substitutes for, 116, 118
— and raw sugar, increased consumption in Northern India during summer months, 100
Ghosh, J. M., on relative value of legumes as recuperating crops (footnote), 92
—, vitamins in Indian footstuffs, 74, 75
Girl-wives, death-rate at childbirth in India, 45
Girls, ages at which puberty is attained by, in India, 214
—, proportion married or widowed below age of fifteen, 214
Gochan, components of, 64
Gojai, components of, 64
Gondia miners, percentage of expenditure among, 181
Gorakhpur, staple foods of workers in, 63, 64
— and Basti, conditions of fodder cultivation and cow-keeping in, contrasted with those of Meerut and Bulandshahr, 133
Goudans of Salem, crude kind of contraception observed among, 218
Government Bureau of Home Economics, U.S.A., 73
Grains, schedule of consumption of, 64
Gram, increase of crops of in United Provinces, 92
—, increased production of, in India, 21
—, total yield of in India, 102
Grassland, deterioration of, how caused, 143
Grazing animals, population per square mile in districts of Ganges Valley, 8
— facilities, absence of, in some over-stocked districts of Bengal, 140
Great Britain, expectation of life for men at birth in, 50
— —, India and Germany, relation between cultivated area and population compared, 127
Green vegetables containing Vitamin A, 74
Ground-nuts, production in, and export from, India increased, 112, 113
Guha, vitamins in Indian foodstuffs, 74, 75
—. *See also* Pal and Guha.
Gujerat, mixed farming and dairying of, xi
Gupta, Sen and Mukerjee, R., standard of metabolism of healthy Bengali men, 60

Hand cultivation, crop yields in India high under, 128
Harvests, good and bad, respective effects, on mortality and birth rate in India, viii
— and vital statistics, relation between in Agra District, United Provinces, 49
Hawaii, sugar production to the acre in India compared with that of, 111

Health standards, low living in relation to, 187
Heifers, scrub bulls allowed to cover, 135
Hemp. *See* Manilla hemp; Lawn hemp
Hindhede, calorie requirements, 57
—, food standard of, 71
Hindu castes, backward, geographical distribution in India, 222, 223
— —, —, localities in which increasing, 222
— —, enumerated, showing deficiency of females, 229, 230
— —, infant marriage among, results of, xiii
— —, literate, geographical distribution in India, 222, 223
— —, low sex ratio among, causes of, 229
— —, number of widows per 1,000 females in, 236
— —, upper-class, neglect of agriculture by, 239, 240
— —, upper and lower, number of females per 1,000 males of all ages, 230
— — — — — and Mohammedans, marital condition of 1,000 females (all ages) in United Provinces, 236
— classes, upper, cause of decline of, 229
—, upper and lower class, and Muslim communities, disparity of growth between, 222
— and Muslim widowed females (ages 15–40), numbers compared, 225, 226
Hindus, advanced and backward, and Mohammedans, disparity of natural variation in Northern India, 223, 224
—, lower-caste Muslims converts from, in Eastern Bengal, 222
—, orthodox, opposed to sale or slaughter of cattle, 144, 145
—, part of India in which predominating, 222
—, provinces in which declining in numbers, 228
—, —, in which increasing and in which declining, 224
Holdings, fractionalisation of, 192, 193, 196, 211, 216
—, — —, in United Provinces, 8
—, — —, prevention by family limitation, 218
—, undue sub-division of, 212
Holland, expectation of life for men at birth in, 50
Hooghly, phenomenal increase of livestock in, 140, 141
Hook-worm, infection in workmen, how caused, 180
—, percentage of rural population found infected with, in Madras Presidency, 175
—, potent cause of inefficiency in India, 175
Housing conditions in cities and villages of India unsatisfactory, 177, 178
Humidity, important governing factor in basal metabolism, 168
Hutton, disadvantages attaching to survival of females, 46
Hydro-electricity, demand for, 210
Hypergamy, 230
—, difficulties of social situation added to, through, 236
—, practice of, 212, 213

Illiteracy, removal of, difficulties in the way of, 216
Immigrant workers, diets of, 171
Imperial Conference, formulation of reciprocal agreements for different parts of the Empire, a task for, 203
Implements used in agriculture in India, 196
Income classes, group expenditure by, group percentage of, 180
— groups, comparison of expenditure by, in India and other countries, 186, 187
India, abortion and infanticide in, prevalence, xiii
—, acreage of rice and wheat in, compared with other countries, 128
—, age at which girls attain puberty in, 214
—, agricultural depression, in, 20
—, agricultural, industrial and mineral production, relative percentages of contribution to national income, 28
—, — production in, rate of growth in excess of rate of growth of population, 20
— and China, cropping conditions in, contrasted, 94, 95
India and China, difference between as regards consumption of animal foods, 62, 63

—, — — and world, crop yields for all crops, tabulated, 190, 191
— and England, average expectation of male lives in, 50
— and Europe, comparison of mining and textile labour in, 173
— and other countries, comparison of expenditure of income groups in, 186, 187
—, animal population excessive in, 131
—, average body-weight in, 55
—, Bengal, United Provinces and England, comparative expectation of life at birth for males and females (1881–1931), 48, 50
—, birth-control in, chief object of, xiv
—, — —, spread of, how hindered, xiii
—, birth rate of, respective expansion and diminution of, how caused, viii
—, bovine population enormous, 153
—, calorie requirements in, 57–60
—, cattle in contrast between in different parts of, 131
—, — —, excessive numbers of, 195
—, — —, increase in numbers, x, xi
—, — —, number kept, compared with those maintained in other countries, 132
—, —, population of, compared with that of China, 195
—, — —, superfluous, 131
—, China, Japan and United States, crop yields per acre in quintals of wheat and rice compared, 190
—, clothing needs less in, 179
—, crop yield *per capita* of great importance, 197
—, cotton cultivation in, decreasing, 121
—, crop adjustment in overcrowded areas, how attainable, xi
—, — yields of, methods of improving, 193
—, cropped areas and output of food grains in, 30, 31
—, crops of, methods of improving output, ix, x
—, — — rotation, urgency of, x
—, dairy products, inadequate supply of, x
—, death-rate higher among females than among males in, 215
India, death-rates and infantile mortality rates compared with those of other countries (1933–1934), 188, 189
—, deficiency of females in, 215
—, de-industrialisation in, xii
—, disbalance in, means of correcting, 207
—, droughts and famines in, periodical recurrence, 21
—, effects of world-wide economic depression on, 205
—, expansion of cultivation in, obstacles to, 10
—, exports of vegetable non-essential oils from, tabulated, 115
—, famines in, mortality from, 35
—, fertility rates in different provinces of, 51, 52, 53, 54
—, fodder-crops, growing of, important and urgent, xi
—, food position in, deterioration, 18, 21
— — —, weakness of, how illustrated, 88
—, — shortage in, estimate of, 23, 24, 25
—, — standards in, theoretical, 71, 72, 73
—, — supply available for, consumption in (1931), 24
—, — —, total amount available, 30, 31, 32
—, Great Britain and Germany, relation between cultivated area and population compared, 127
—, industrial development in, tardiness of, 204
—, — production of, restrictions on market for, 28
—, infant and disparate marriages in, 53
—, — mortality rate in compared with that in England, 44, 45
—, influenza epidemic (1918–1919), 37, 40, 45, *see also* Influenza
—, intensive cultivation in, obstacles to, 192
—, inter-provincial migration in, 200
—, — — — advocated, xiii
—, introduction of soya bean into, urgent, 104
—, inverse correspondence between cattle density and crop area *per capita*, 130
—, live-stock in, feeding standards of, 129

India, live-stock in, increase of, during last twenty years, 132
—, low expectation of life in, cause of, 50
—, major provinces of, total population and density for men and animals, 7
—, meat consumption restricted in, 63
—, minimum subsistence family holding in, 4
—, mortality from chief epidemic diseases in (1901–1931), 37
—, — of, respective expansion and diminution of, how produced, viii
—, number of acres growing food-grains, 129
—, nutrition levels in different regions and classes in, 69 *et seq*
—, oil-crushing industry in, need for development, 113, 114
—, oil-industry in, 114
—, overcrowding of agriculture in, means of mitigating, xiii
—, peasantry in, sources of food energy for, 126, 127
—, percentage of calories to be provided by fat in, 72
—, population capacity, estimate of, 26. *See also under* Population
—, —, pressure in, remedies, 190 *et seq*
—, production of oil-seeds showing no increase in, 104
—, principal industries in, index number of value weights for, production of, 27
—, production in, and export of Jute from, now limited, 120
—, protein standard (footnote), 72
—, provinces of,
—, — —, food intake and food requirements, diagrams illustrating, 80, 81
—, increase of number of married females in, 13
—, —, showing largest consumption of animal products in dietary, 123
—, — —, with smallest crop area *per capita* maintaining largest number of cattle, 130
—, reduction of cattle numbers in, urgent, 151
—, rice area in, 191
—, — growing provinces of, 22
—, — production in, fall of, 22
—, rural districts in, receiving large money-orders, 201
—, scheme of assisted emigration overseas desirable, 303
India, sex defect in, complex problem of, 233
—, small family system in, adoption, urgency for, xiii
—, social fabric in, factors tending to loosen, 211
—, sugar cane area in, total, 192
—, — cane farming and industry in, 109
—, — production in, 109
—, — —, compared with that of Java, 109
—, systematic crop and food-planning in, measures for, 106, 107
—, tobacco industry in, 119
—, total yield of grain in, 102
—, tropical, sugar-cane production in, unimportant, 110
—, variety of pulses and cereals consumed in different parts of, by workers and peasants, 69
—, villages of, housing conditions unsatisfactory, 178
—, vital indices, 1921–30; 1931–35, 14
—, waste lands in, total acreage, 26
—, wheat area in, 191
—, — production in, recent increase, 22
—, — yields of China and United States compared with those in, 194
—, Northern, appetite of inhabitants compared with that of dwellers in Bengal and Madras, 71
—, —, cereals and other foods of, average percentage composition, 67
—, —, climate affecting sex-ratio in, 234
—, —, — and diet, stimulating, 85
—, —, disparity between fecundity and culture greatest in, 221
—, —, — of natural variation of advanced and backward Hindus and Mohammedans in, 223, 224
—, —, expansion of cultivation in, difficulties of, 11
—, —, food standard for, 73
—, —, housing conditions unsatisfactory in, 178
—, —, increased consumption of *ghee* and raw sugar in, during summer months, 100
—, —, kind of diet indicating pressure of population on subsistence in, 106

India, Northern, peasants' diets, carbo-hydrates in, 65
—, —, rate of growth of Hindu literate castes in, 222
—, —, recurrence of drought years in, 23
—, —, root vegetables available in, 102
—, —, social composition of, analysed, 221, 222
—, Southern deficiencies of diet in, 164
—, —, food standard for, 73
—, —, incidence of premature births in, compared with that in north of India, 162
—, —, lower metabolism in, 85
—, —, poverty in, how indicated by diet, 106
—, —, pregnant females in state of avitaminosis B in, 162
—, —, Vitamin A deficiency among children in, 162
Indian dietary, important sources of calcium in, 74
— diets, low nitrogen value of, how determined, 58
— —, smaller percentage of, nitrogen in, 56
— peasants' dietary, defects of, 65, 66, 87, 187
— — —, drawbacks of, 61, 62
— —, food of, seasonal deterioration, 66.
— peasant family food, energy consumed by, how derived, 126
— people, decline in physique of, in relation to dietaries, 167
— population, proofs of low standard of life of, 189
— Population Conference (1936), vii
— workers, sickness, absenteeism and mortality among, 175
— —, weight of. 172
— working man and British working man, diets, and caloric value of diets compared, 82, 83
Indians, lower basal metabolic rate of, reason for, 71
—, metabolism, studies on, references to (footnote), 59
—, muscular tone lower than that of Westerners, 71
— and Europeans, food consumption compared, 56, 57
Industrial cities in India, overcrowding in, 177
— cropping and food-cropping, combination of important, xii
Industrial crops, 108 *et seq*
— development in India, tardiness of, 204
— demand for electricity, 210
— efficiency, factors contributing to, 84
— inefficiency, diet in relation to, 82
— planning, forward programme of advocated, 207
— — in correction of disbalance in India, 207
— prices in India, fall and then rise of, 198
— worker in India, calories yielded by diet of, 82
— workers, effects of malnutrition upon, viii, ix
— — in Provinces of India, facts as to number of, 206, 207
Industrialisation in the villages, means of promoting, 210
—, rural, 108 *et seq*
Industries, ancillary, development of, 208
—, decentralisation and ruralisation of, 210
—, existing, development of, 208
—, loss of numbers of workers in, xii
—, new establishment of, 208
—, principal, in India, index number of value weights for production of, 27
Inefficiency and poverty, 173 *et seq*
Infant marriage, 213, 214
— —, among lower Hindu castes leading to increase of population, xiii
— and disperate marriages in India, 53
—, mortality of, one principal cause, 163
Infants, mortality-rate in India, compared with that in England, 44, 45
Infanticide, 213
—, female, 232
—, still prevalent in India, xiii
— through neglect, 234
Infantile mortality rate (1933–1934) in India and other countries compared, 188, 189
Influenza epidemic in India (1918–1919), mortality from 37, 40, 44, 45
Intensive cultivation, benefits of, 190
— — —, obstacles to, 192

Inter-Allied Food Commission, minimum fat ration during the war adopted by, 72
Iron compounds contained in leafy vegetables (*saks*), 126
—, sources of, in Indian dietary, 74
Irrigated zones, inferior live-stock derived from, 137
Irrigation, difficulties of, in United Provinces, 11
—, effects upon food grains, 107
— *See also* Flow irrigation; Well irrigation

Jabi Dharma, function of, 211
Japan, importation of rice by, 29
—, increase in consumption of fish in, 99
—, prevalence of beri-beri in, 160
—, protein standard adopted in (footnote), 71
—, reason for non-existence of animal raising in, 153
—, rice becoming staple food in, 88
—, silk industry in, 122
—, smallness of number of cattle in, 131
—, India, China and United States crop yields per acre in quintals of wheat and rice compound, 190
Japanese, average weight of, 55
—, diet of, 63
Java, protein standard in (footnote), 71
—, sugar-production in India compared with that in, 109, 111
Javanese, average weight of, 55
Jaunpur district, diminution of double-cropped area in, 8, 9
Jessore, phenomenal increase of live-stock in, 140, 141
Jherria Mines Board of Health, report of health visitor, on poverty and diseases in coalfields district, 185
Johne's disease among cattle, increasing, 139
Jowar, 89
—, increased production of, in India, 21, 87
—, malted and mixed with other grains, value of, 98
Jute, crops replacing, 91
—, cultivation of, diminution, 91
Jute Enquiry Committee, recommendations of, 120
— mills in Bengal, statistics relating to absenteeism due to sickness in, 175
—, production in and export from India now limited, 120
— sacks, elimination of as containers, for grain in transit, 120
— substituted by paper or cotton for making bags, 120

Kabuli grain, 102
Kachus, 105
Kalai, 105
Kankinanarah Labour Union of Bengal, figures for comparison of Scottish and Bengali weavers in spinning industry, 173, 174
Kartar Singh, table showing relative importance of animal and vegetable products in Punjab diets, 123, 124, 125
Kayasthas, percentage of decrease, 223
Keratomalacia in Southern India, 163
Keratosis, follicular, in Southern India, 163
Kodo, 89
Kuczynski's methods of measuring vital trends, 39
Kula, function of, 211
Kurmis, percentage of, decrease, 223

Labour supply, occupational, distribution of, means of promoting, 209
Labourers, half-agricultural, half-industrial, 210
— and prisoners, comparative figures of weight of, in the different provinces, 166
Lad, P. M., "Balance of Births and Deaths," 51
Land in India, economical use of, 108
—, unreclaimed in India, 10
— utilisation, maximum, 126
Law of Consent, violations of, 214
Leafy vegetables (*saks*), dietetic and nutritive value of, 126, 169
Legumes, amino-acids in, dietetic value of, 96

Legumes, co-efficient of digestibility, 72
—, relative value as recuperating crops (footnote), 93
—, substitution for grains, 102
Leguminous crops, importance of, in India, 92
— —, increase of, how attainable, 93
Lemon, fruits richer in Vitamin C than, 75
Leprosy, means of combating, 157
—, possible cause of, 157
—, where most prevalent in India, 157, 163
Linseed, production in and export from India, 112, 113
Literacy, fecundity and survival value, inverse correspondence between, 237, 239
—, position of in Provinces of India, 188
Live-stock, condition of in dry and moist areas contrasted, 138
—, feeding standards of, in India, 129
—, increase in India during last twenty years, 132
—, inferior, derived from irrigated zones, 137
—, nutrition of, effect on milk (footnote), 143
—, nutritional value of feeding stuffs for, 130
—, superior, derived from regions of inadequate rainfall, 137
Low living in relation to health standards, 187
Lucas, E. D., on overcrowding in villages (quoted), 178
Lucknow, over-crowding in, 178
—, staple foods of workers in, 63
— University Physiological Laboratory, figures of nitrogen metabolised per kilogram of body-weight, 57
— — — —, investigation of basal metabolism of peasants in the United Provinces, 59
Lusk's co-efficients of comparison of food requirements of children with those of an average man or woman, 23
Lyallpur, abundant supply of calories yielded by menu consumed by *jat*, cultivators, 165

McCarrison, Maj.-Gen. R. dietetic value of *ragi* or *bajra* mixed with other foods, 98
McCarrison, difference in physique between inhabitants of Northern and Southern India, 167
—, experiments with rats to determine results of feeding on certain national diets of India, 167, 168
—, food standard of, 71, 73
—, note on nutrition (footnote), 144
—, relative value of nutrients in India, 66, 67
—, standard of fat in diet fixed by, 72
—, theoretical standard of diet applicable to India, fixed by, 60
McCay, Lieut.-Col. D., decline in physique of Indian people in relation to dietaries, 167
—, investigations into protein ingestion and nitrogen secretion in Bengal, 71
McCollum, successful dietaries evolved in warmest climates, 169
— and Simmonds, diet recommended by, 125
McCulloch, estimate of population of India, 3
Madras, appetite of inhabitants compared with that of dwellers in Northern India, 71
—, diseases due to faulty diet found in, 162
—, emigration from, explained, 202
—, extension of cultivation not keeping pace with extension of population in, 192
—, increase in numbers of workers in industry in, 207
—, increase of oil-mills in, 114
—, rice-production in, deficit per annum, 22
—, prevalence of stone in, 162
— Presidency, number of women in, 231, 232, 234
— —, percentage of rural population found infected with hook-worm, 175
Madrassis, inferior physique of, factors governing, 170
Mahua liquor, drinking of, 185
Maize, alfalfa leaf and cooked peas, dietetic benefit of, 125
—, crop and food of poorer classes in India, 87
—, increased production of in India, 21

Maize, rice and wheat, nutritive qualities compared, 86
Malaria, exercising more lethal effect on women in malaria-haunted zones, 234
— in India, economic loss entailed by, 38
— — — — —, mortality from, 37, 38
— — — — —, age-incidence, 38
— — —, number annually suffering from, 38
— — —, potent cause of inefficiency, 175
—, prevalence in Bengal, 13
Male births, proportion to female in India, 51
— lives, average expectation of in England and India, 50
Males per mille, number of, in advanced, intermediate and illiterate castes (including Muslims), 238
—, proportion of females to, in India, 51
Malnutrition due to unsuitable diet in Indian villages, 42
—, effects among cattle, 138, 143
—, evil effects of, 47
—, in India, 154
—, in mining areas, 185
— in women and children, effects of, 43
—, incidence of, 154 *et seq*
—, respective effects on industrial workers and cultivators, viii, ix
Malthus, Thomas, doctrines of, now acknowledged valid, 2
—, moral restraints of, 212
—, warning enunciated by, 1
Malthusian checks, 34, 40
— —, operation of, how indicated among Indian population, 190
— —, positive, in India, 48
— equilibrium, disasters establishing, 200
— Law of Diminishing Returns, 7, 9, 11
Mandua, 88, 89
Mango, sourse of Vitamins A, B_1 and B_2, 75
Mangoes, plantations of, where situated, 108
Manilla hemp, competition with Indian hemp, 121
Man-land ratio, contribution to exclusion of foods of animal origin in India, 123
Man-power and crop yield, relation between, 196
— value, average and total of population of India, 23
— — of present population of India, 25
Manure, burning of, owing to scarcity of fuel, 195
—, use of human excrements as in China, 195
Manures, organic, need for, 106, 107
—, utilisation of oil-cakes as, 114
Marital condition of 1,000 females (all ages) of upper and lower Hindu castes and Mohammedans in United Provinces, 236
— condition of 1,000 of each sex (all ages) in Eastern Bengal, 227
— regulations, dysgenic, 235
Marriage, consummation of, followed within ten years by deaths of young wives, 215
—, postponement of, 212, 213
— *See also* Child Marriage; Infant Marriage.
Marriages, less frequent, customs contributing towards, 212
— *See also* Infant and disparate marriages
Mash Kalai, cultivation of, replacing jute, 91
Masur, 105
Maternal mortality at childbirth in Madras, 45
Maternity, deaths of women in later periods of, 46
Maths, seclusion in, 212
Meat, consumption in China, 63
— retarded, 64
Medicine, expenditure on, small, among working-class families, 181
Meek, D. B., value weights for production of principal industries in India, 27
Meerut and Bulandshahr, conditions of fodder-cultivation and cow-keeping in, contrasted with those of Gorakhpur and Basti districts, 133
Megaw, Sir John, death-rate of girl-wives in childbirth in India, 45
—, enquiry into malnutrition in agricultural villages of India, 42
Metabolism, investigations for Indians, 59
—, lower, in Bengal and Southern India, 85

Metabolism, lower, of inhabitants of tropical climates, 71
— of Bengalees, 59
— studies on Indians, references to summary of (footnote), 59
— *See also* Basal Metabolism
Meteorological and vital cycles, six-yearly, 40
Middleton and Jacob, practice of polygamy among the Muslims, 226
Midwife, women rendered incapable by, of having any more children, 218
Migration, inter-provincial in India, 200
—, advocated, xiii
Milch cattle, inadequate grazing for, 135
— cows, used for working in fields in Germany, 147, 148
Milk, amounts of land required to produce 1,000 calories in form of, 124
—, demand exceeding supply, 149
—, effect of nutrition of livestock on, 143
— fever among cows, 139
— of Indian cows and buffaloes deficient in calcium, 79
— production in India, caloric value of, 24
—, skimmed, 149
—, —, benefit of (footnote), 99
— and milk products, addition to Indian dietary important, 99
— — — —, dietetic sources of protein, 62
— — — —, expensive in Calcutta, 158
— — — —, relative value of, in India, 67
Millets, cheaper, use of, in India indicating lower purchasing power, 89
Mineral deficiency in diets of family of Brahmin farmers, 79
Mining areas, diseases prevalent in, 185
— labour in India and Europe compared, 173
Mis-population as serious as over-population, xiv
Missi rotis, article of diet, 64
Mohammedan females, number per thousand in each age period living as wives of second husbands 226
— —, number, living as widows, 226
Mohammedan married males, proportion higher than among the Hindus, 227
Mohammedans in India, prospective increase of, 12
—, percentage of increase in India, 224
—, polygamy among, results of, xiii
—, rapid increase of, 228
— and advanced and backward Hindus, disparity between, in Northern India, 223, 224
— and Hindu castes (upper and lower) in United Provinces, marital condition of 1,000 females all ages, 236
— *See also* Muslim, Muslims
Monastries, seclusion in, 212
Money-orders, large, rural districts in India receiving, 201
Monsoon region, supplementary crops in, 94
Moreland, estimate of population of India at time of death of Akbar (1605), 3
Morimoto, food consumption of Japanese in relation to weight, 55
Mortality, high, following high birth-rate, 40
— in India, respective expansion and diminution of, how caused, viii
Moth, 89
Mothers, Indian, occupations required of, notwithstanding child-bearing, 214
von Mueller, F., effects of under-nutrition, 163, 164
Mukerjee, H. N., metabolism investigations for Indians, 59
Mukerjie, R., Indian emigrations discussed by, in *Migrant Asia* (footnote), 203
—, *Migrant Asia*, xiii
—, *Rural Economy in India* (footnote), 163
— and Gupta, standard of metabolism of healthy Bengali men, 40
Mung dal, alkali radical content of, 105
Muslim castes, number of females per 1,000 miles of all ages, 230
— community, increase of, in India, 222, 223
— and Hindu widowed females (ages 15–40), numbers compared, 225, 226

Muslim and upper and lower class Hindu communities, disparity of growth between, 222
Muslims, converts from lower-class Hindus in Eastern Bengal, 222
—, larger proportion of births among, how shown, 227
—, now addicted to drink, 185
—, parts of Northern India in which predominating, 222
—, wives of, serving as field labourers, 227
Muttra-Etawah region, rapid fall of subsoil water level in, 11
Myerson, Inheritance of Mental Diseases and Social Psychology (footnote), 164
—, influence of chemical and foodstuffs on sex ratio and fertility in animals, 233

Nagpur, overcrowding in, 177
Netherlands, the, Cattle Crisis Act passed in (1933), 151
—, maternal mortality at child birth contrasted with that in Madras, 45
—, mixed farming in, 147
New Zealand, expectation of life for men at birth in, 50
Nitrogen excretion, protein ingestion and investigations into, 71
—, minimum amount necessary in diet, 56
—, position of, in dietaries, 56
— metabolised per kilogram of body weight, figures showing, 57
— value, low, of Indian diets, how determined, 58
Nitrogenous foods, greatest amount taken in colder climates, 56
Non-vegetarian classes, diet of, 65
Norman-White, Major, on injurious effect on Indian worker's health upon transference to industrial centres, 176
North-West Frontier Province, diet of, 165
— under-populated, 203
Norway, expectation of life for men at birth in, 50
Nutrients, foodstuffs arranged in order of relative richness in, 70
—, relative value of in India, 67
Nutrition, index of, 162
— Institute, Tokyo, protein standard adopted at (footnote), 71
Nutrition levels in different regions and classes in India, 69 *et seq*
Nutritional value of feeding stuffs for live-stock, 130

Œdema, malnutritional, 162
—, nutritional, cases of, 157
Oestrus, suppression of, how caused, 139
Oil, extraction from soya beans, 114
Oil-cakes, utilisation as manures, 114
— -crushing industry, establishment in India desirable, 118
— — —, need for development in India, 113, 114
— -mills, increase in India, 114
— -seed crops, decline in Bengal, 91
— -seeds, different kinds, production in and export from India, tabulated, 113
— —, export from India, 112
— —, importance of, in India, 111
— —, production not increased in India, 104
— — and oil-cakes, export duty on, 118
Oils, vegetable, non-essential, exports from India, tabulated, 115
— —, replacing or supplementing animal fats in diet, 103
— and oil-bearing materials from seeds exported from India, countries producing, tabulated, 117, 118
Olver, "Live-stock Improvement in India" (quoted), 146
Optimum nutrition, 154
Orange, fruits richer in Vitamin C than, 75
— industries, where situated, 109
Oriental countries, relative over-population in, table showing, 6
Orissa. *See* Bihar and Orissa
Orr, Rowett Institute, 73
Osteomalacia, causation of, in India, 162
Ottawa Preference, effect on export of linseed from India, 112
Oudh, distribution of fertility rate in, 54
—, increased production of cheap food grains in, 88
Outstill auction systems, introduction of, effect, 184
Over-crowding in industrial cities in India, 177
— -population, economic effects of, 34

Over-population, fear of, arising since European War, 2
— —, measure of, 4
— —, polygamy factor in causation of, 225
— —, relative, in the Oriental countries, table showing, 6
— —, social effects of, 34
— —, significance now recognised in the East, 2
Over-seas emigration, scheme of, desirable for India, 203

Paddy, percentage increase of area and of output in Bengal, 90
Pal and Guha, analysis of nutritional values of cooked diets from students hostels and middle-class families in Calcutta, 79, 82
Papanidcolaou, experiments on effects of undernutrition, 163, 164
Pasteurisation, 147
Pearl, measurement of biological health of community by vital index, 39
— and Taylor, methods of estimating total population capacity and food shortage, vii
Peas, increase of crops of in United Provinces, 92
Peasant and working-class diets in India, analysis of, 78
— — — — — in India, collection and examination of, viii
— — — — — —, distribution of quantities of food-materials and calories in, tabulated, 78, 79
Peasants, diet in United Province, caloric energy of, 58
— in United Provinces, number of calories needed by, 59
Peasantry of India, China and United States, sources of food energy for, 126, 127
Pellagra-like stomatitis in children of Southern India, 163
Penrose, prevalence of beri-beri among Japanese students, 160
—, rice diet in Japan (quoted), 88
Persia, polygamy less prevalent in, 228
Phosphorus, sources of, in Indian dietary, 74
Phthisis, death of young wives from, 215
Physical characteristics of Indian peoples, how determined, 85
Physique, decline in, in relation to dietaries, 167
Plague in India, mortality from, 37, 38
— regions of India, women more severely affected, 234
— Plains of India, hydrographical conditions altered, 11, 12
Plant breeding, increasing yields of crops in India, 194
Plough cattle, low draught capacity of, in India, 195
Polygamy, abolition in Turkey, 228
— among Mohammedans, result of, xiii
—, areas of greater prevalence, 225
—, extent of among Punjab and Delhi Muslims, 226
—, factor in causation of over-population, 225
—, legislation regarding required, 228
—, less prevalent in Persia, 228
Population, and food-supply in India, variation of, index number of, 18
—, danger of outstripping means of subsistence, Malthus's warning as to, 1
—, expanding, evil-effects of, 216, 217
— increase, best means of combating, 217
— of (or in) India, balance of, 12, 13, 14
— — — and cultivated area, index numbers, 16, 17
— — — — —, and volume of crop production, index numbers, 17
— — — —, dependence on agriculture, 205
— — — —, disparity between increase of and industrialization, 204
— — — — — — — — —, table illustrating, 199
— —, dysgenic trends of, 221
— —, effect of remarriage of widows upon, 225
— —, estimate of capacity, 26
— —, evil effects of diet deficiency upon, viii
— — — —, forecast of amount of increase by next Census (1941), 14, 205
— — —, growth of, 3
— — — — —, factor accelerating, 14, 211
— — — —, fertility of, must be under restraint, 219

Population of (or in) India effect estimate, growth of means of checking formerly practised, 212, 213
— — — — in middle of nineteenth century, 3
— — — in 1935, 3
— — —, increase since the seventeenth century, table showing, 3
— — — —, of social factors contributing towards, xiii
— — — — —, strata of society in which more in evidence, 237, 239
— — —, man-value, average and total, 23
— — —, mortality, fall in, 14
— — —, movement of, 1910–11 to 1934–35, 15, 16
— — —, present, man-value of, 25
— — —, sudden expansion accompanying rise in prices, 197, 198, 200
— — —, total requirement of calories for, 23, 24
— — —, trends of, in relation to food-suppply, 15
— — —, various estimates in past times, 3
—, increase in, indirect results of, 216
—, investigations, hygienic and sociological questions implicated in, xiv
—, mortality of, relation between food supply and, ancients' conception of, 1
— pressure, agricultural adaptation to, 85 *et seq*
— — and changes in cropping in India, 86
— — in India, heavy, 21
— — — — — remedies, 190 *et seq*
— — —, ultimate cause of vegetarianism, 125
—, variation in, at certain age periods in United Provinces, Bihar and Orissa and Bengal, 43
— *See also* Over-population
Potato diet, economic value of, 100
Potatoes, growth of, in place of rice, 101
Poverty and inefficiency, 173 *et seq*
Prājapati, supposed double function of, 1
Pregnant females in state of avitaminosis B_1 in Southern India, 162
Pre-puberty consummations, 214
Prisoners and labourers, comparative figures of weight of, in the different provinces, 166
Protective tariff in correction of disbalance in India, 207
Protein, content of *dals*, 102
— — of soya bean, 97
—, dietetic sources of, 62
—, Indian peasant dietary deficient in, 86
— ingestion and nitrogen excretion, investigations into, 71
— intake, minimum, in India, 71
— — —, of Bengalee, 173
— standards (footnote), 71, 72
— and calcium deficiency in Indian diets, 82
Proteins, inadequate intake of, deficiency diseases due to, 158
— of certain crops in India, biological value of, 68
—, quality of in rice, potato and pea, compared with that in cereals, 68
Provinces of India, position of literacy in, 188
Puberty, age at which attained by girls in India, 214
—, age of, reduced by climate, 214
Pulses, advantage of increased area under, in India, 103
—, alkali content of, 105
— containing Vitamin A, 74
—, cultivation of in crowded areas of India, xi
—, quick-growing, cultivation in semi-wet areas, 101
—, relative value of, in India, 67
— and cereals, variety of consumed in different parts of India by workers and peasants, 69
Punjab, the, castration adopted in, 151
—, better feeding of dairy animals in, 143
—, diet of agricultural workers in, 62
— — —, rich and nutritive, 165
— diets, relative importance of animal and vegetable products in, tabulated, 123, 124, 125
—, distribution of fertility rate in, 54
—, facility for cattle-breeding in, 144
—, family limitation in, 218
—, fertility rate of, 52, 53
—, housing conditions in unsatisfactory, 178

Punjab, low incidence of dysentery in, 163
—, mixed farming and dairying of, xi
—, slight diminution of industrial workers in, 206
— and Delhi Muslims, extent of polygamy among, table showing, 226
Punjabis, diet of, 166
—, strong physique of, climatic factor in relation to, 168

Rabi cropping, decline in Western Bengal, 91
— crops, renewed cultivation in Eastern Bengal, 90, 91
Racial factor in sex ratio, 231
— suicide, how foretold, 237
Ragi, mixed with other foods, dietetic value of, 98
—, nutritive quality, 86
Rainfall, inadequate, superior livestock derived from regions of, 137
Raja, probable trend of population growth in India (quoted), 14
Rajputs, percentage of decrease, 223
Rajwade, Laxmibai percentage of girls married below age of fifteen, 214
Rape-seed, production in and export from India, 112, 113
Rats, experiments on, to determine results of feeding with certain national diets of India, 167, 168
Ravine lands, formation in United Provinces, 11, 12
Refrigeration, 147
Reciprocal agreement between different parts of the Empire suggested as a task for the Imperial Conference, 203
Regional factor in causation of low sex ratio among Hindu castes, 229, 230
Religious objections to sale or slaughter of cattle, 144
Reproduction, economy in, need for, 219
— —, ill-results from absence of, 219
Reproductive powers, impairment of, how caused, 46, 47
Rest pauses, distribution of between intervals of work in factories, 84
Review of Agricultural Operations in India (quoted), 103
Rice, acreage per yield in India and other countries compared, 128
Rice, amount produced by Burma, 22
— area in India, 191
— becoming staple food in Japan, 88
—, crop yields per acre in quintals in India, China, Japan, and United States compared, 190
—, deficient in Vitamin A, 159, 160
— diet in combination with another cereal, 101
— -eating peoples, mixed diet preferred by, 166
—, fall in price of (1928–30, 1931–33), 198
— -growing provinces of India, 22
—, home-pounded, dietetic superiority of, 161
—, importation as well as export by China, 29
—, maize and wheat, nutritive qualities compared, 86
—, milling and polishing of, harm done by, 159
—, polished, dietetic danger of, 162
—, —, preference given to among all classes, 160, 161
—, production of in India, fall of, 22
—, red, eaters of, 161
—, staple crop to supplement rice needed, 101
—, starch in causing undernourishment, 101, 102
—, successive crops of, 94
—, time required for maturing of crops, 94
—, unpolished, methods of using, 166
—, use of potato in place of, 101
—, variations in chemical qualities of different kinds of, 68
— —, and legume eaters and wheat-and-legume eaters, physique compared, 171
— and wheat eaters in India calories necessary for, 24
Rickets, causation of in India, 162
—, high incidence in Bengali children, 172
—, regions in which more prevalent in India, 162
Rivers, pollution of, detrimental aspect, 100
Root-crops, growing of, in crowded areas of India, xi
— vegetables, nutritional importance of, 105
— — (radishes, carrots, onions) available in Northern India, 102

Root vegetables, treatment with organic manures, 106
Ross, adaptive fertility, 219
Rowett Institute, 73
Royal Commission of Agriculture on regulation of number of cattle within a district, 133
— Statistical Society, estimate of population of India (1847), 3
Rural industrialisation in India, importance of, 111
Russell, maternal mortality-rate in Madras, 45

Saks (leafy vegetables), 89
—, nutritive value of, 126,
Sandal-wood oil, value of, 115
Sann hemp, acreage under in India, 121
— —, export trade in from India, 121
— — and *mash kalai*, cultivation of replacing jute, 91
Saugor Tahsil, distribution of cattle in, 148, 149
Scotch and Bengali weavers in spinning industry, figures of output compared, 173, 174
Scotland, fertility rates in, 54
Scrub bulls, allowed to cover heifers, 135
— —, castration of, urgent, 150, 151
— cattle, economic folly in increasing, 142
— —, immune to ordinary live-stock diseases, 142
Seasonal deterioration of food of Indian peasants, 66
— influence on basal metabolism, 60, 61
— rise and fall of basal metabolism, 61
Sedentary workers, minimum and maximum diet planned for (Mrs. A. G. Strong), 60
Sesame, production in and export from India, 112, 113
Sex composition of castes, 235
— defect in India, complex problem of, 233, 234
— -proportions, cause of disparity of, in India, 46
— ratio, factors influencing, 231, 233
— —, low, among Hindu castes, causes of, 229
— —, —, chief cause of decline of upper Hindu classes, 229
Sex relationship, casual, 218
— —, casual, result of, 185
Sexual intercourse, prolonged abstinence from, for married persons, 212
Sherman, food standard of, 71
Shirras, Findlay, on population of India, 3
Shoes, lack of, among workmen, ill-results of, 176
Silk industry in China and Japan, 122
—, production of, once important in Indian agriculture, 122
Simmonds and McCollum, diet recommended by, 125
Sind, expansion of wheat area in, 23
Sinton, Lieut.-Col., mortality from malaria in India, 38
Sitapur district, Oudh, condition of cattle-population in, 134
Skimmed milk. *See* Milk, skimmed
Small cultivators' agency in increasing scrub cattle, 142
— family system, adoption of in India, urgent, xiii, 217
— — habit in the past, 211 *et seq*
— scale trade and rural industries substituting or supplementary to agriculture, 209
Smallpox in India, mortality from, 38
Soap manufacture, use of vegetable oils in, 116
Social control, means of, no longer efficacious, 211
— fabric in India, factors tending to loosen, 211
Soil fertility, regeneration of, and crop production, balance between, how upset, 195
Sokhey, metabolism of male medical students in Bombay, 60
Soya bean, cultivation of, 101
— —, dietetic advantages of, 97
— —, dietetic uses of in China, 104
— —, value of, how diminished, 100
— —, introduction into India, urgent, 96, 97, 104
— —, protein content of, 97
— —, export from China, 114
— —, proportion pressed for oil before shipment from China, 114
Starch in rice causing under nourishment, 101, 102
—, preponderance of, in Indian peasant dietary, 187
Stiebeling, set of standards of food requirements compiled by, 73, 82

Stieve, H., researches on effects of under-nutrition, 164
Stockard, experiments on effects of under-nutrition, 163, 164
Stomach, ulcer of, regions in which more prevalent in India, 162
Stomatitis, pellagra-like, in children of Southern India, 163
Stone. *See* Calculus
Strong, Mrs. A. G., minimum and maximum diet for sedentary workers planned by, 60
Subsistence, means of, danger of population outstripping, Malthus's warning as to, 1
Sugar-cane, acreage under in India, 109, 192
— — crops, diminution of area of, how attainable, 93
— — crushers, demand for, 210
— — farming and industry in India, 109
— —, increased production of, 21
— —, yields in various parts of India enumerated, 110
—, home production in India, and import, calorie value of, 25
— import and production in India distribution of, 111
— industry alone, showing an increase in workers, 205
— — in India, how to be established on sound lines, 111
— production to the acre in India compared with that elsewhere, 111
Summer rain in monsoon region, favourable and unfavourable effects of, 94
Sündbarg's age categories, 12, 13
Sunspot minima and maxima, recurrence of famines in India with, 36
Survival value, fecundity and literacy, inverse correspondence between, 237, 239
Switzerland, expectation of life for men at birth in, 50

Taboos and injunctions, religious, governing marital intercourse, 213
Tapioca, percentage increase of area and of output in Bengal, 90
Tariff policy, more vigorous, advocated, xiii
Taylor, on advantages of the soya bean, quoted, 104
— *See also* Pearl and Taylor
Tirra, components of, 64
Tobacco industry, in India, development of, 119
— —, — —, means for improvement of, 119
Tongue, lips and mouth, ulceration of, 156
Travancore, castes in, showing an excess of females over males, 232, 233
— Census Superintendent, remarks on correspondence between high sex ratio and racial elements, 232
—, crops maintaining a dense population in, 89
—, money crops grown in, 80
Tropical climates, lower metabolism of inhabitants of, 71
— or sub-tropical regions, basal metabolism lower in, 59
Tube wells, demand for, 210
Tuberculosis among cows, 139
—, amount of prevalence in Southern India, 162
— in Cawnpore, death-rate among females, 177
— —, mortality from, 177
—, potent cause of inefficiency in India, 175
Turkey, abolition of polygamy in, 228

Under-nutrition, 154
— —, effects of, enumerated, 164
Unemployment, industrial, increase of, 205
United Provinces, acreage of *usar* lands in, 12
— —, average net cultivated area diminishing, 9
— —, birth-rate in, fall of, 41
— —, caloric energy of peasants' diet in, 58
— —, death-rate in, reduction of, 48
— —, difficulties of irrigation in, 11
— —, diminution of double-cropped areas in, 8
— —, emigrants from, decline in numbers, 201
— —, emigration from explained, 202
— —, — — (1921), tabulated, 201
— —, formation of ravine lands in, 11, 12
— —, fractionalisation of holdings in, 8
— —, immigrant workers from, in Bengal, diet of, 171

United Provinces, increase in crops of grain and peas in, 92
— —, jail diet, standardised, daily per head consumption of food among Cawnpore workers compared with, 65
— —, malaria in, deaths from, annually, 38
— —, marital conditions of 1,000 females (all ages) of some of upper and lower-caste Hindus and Mahommedans, 236
— —, mixed farming and dairying of, xi
— —, number of calories needed by peasants of, 59
— —, over-crowding in villages of, 178
— —, population of, increase in, 3
— —, staple foods in, 63, 64
— —, undersized holdings in, 193
—, variation in population at certain age-periods in, 43
— —, vital indices in congested districts of, 39, 40
United States of America, decline in use of cereals in, 86
— — Department of Agriculture, comparison of acreage needed by vegetable and animal foodstuffs to produce a given number of calories, 124
— —, maternal mortality at childbirth in Madras contrasted with that in, 45
— —, peasantry in, sources of food energy for, 126, 127
— —, wheat yields in, compared with those in India, 194
— —, India, China and Japan, crop yields per acre in quintals of wheat and rice compared, 190
Usar lands, how formed, 12

Vegetable cattle-fodder, further supply needed, 101
— diet, presumed sufficiency of, 125
— oils as food, 115
— —, use in soap manufacture, 116
— and animal foodstuffs, acreage required by respectively to produce a given number of calories, 124
— — — products, relative importance in Punjab diets, tabulated, 123, 124, 125
— and fruit diet, greater dependence on, important, 100
— protein as body-builders, 56
Vegetables, leafy (*saks*), nutritive value of, 126
Vegetarianism, ultimate cause of, 125
Venereal disease resulting from casual sex relationship, 185
Villages, addition of butter to diet in, urgent, 99
—, Indian, industrialization of, means of promoting, 210
— —, over-crowding in, often worse than in towns, 179
Vital indices in congested districts of the United Provinces, 39, 40
— —, India, 1921–30; 1931–35, 14
— statistics and harvests, relation between in Agra District, United Provinces, 49
— and meteorological cycles, six-yearly, 40
Vitamin A, addition to village diet, urgent, 99
— contained in mango, 75
— deficiency, destruction of eyes resulting from, 165
— — — among children in Southern India, 162
— — — in diet of cows, effect of, 139
— —, fish containing, 74
— —, green vegetables containing, 74
— —, loss of in *ghee* through boiling, 163
— —, pulses containing, 74
— —, rice deficient in, 159, 160
— A, C, D, diets poor in, 65
— B, wheat a source of, 68
— B_1, sources of, 75
— B_2, sources of, 75
— C, contents in Indian fruits, tabulated, 76, 77, 169
— —, fruits rich in, 75
— —, root vegetables containing, 105
Vitamins, deficiency of, causing infantile mortality, 163
—, importance to growing children and to adults, how manifested, 164
—, in Indian foodstuffs, 74
— — — —, tabulated, 75, 76

Waste lands in India, percentage in various provinces, 27
— — — —, total acreage, 26
Water-logged wastes, formation of, disastrous, 12

Weight of Indian workers, 172
— of prisoners and labourers in the different provinces, comparative figures, 166
Well-irrigation, difficulties in way of, 11
Wheat acreage, continued diminution in, result, 101
— — and yield in India and other countries compared, 128
— area in India, 191
—, crop yields per acre in quintals in India, China, Japan and United States compared, 190
—, fall in price of (1928–30), 198
—, grains substituted for, in India, in years of scarcity, 89
—, grown with barley in small holdings, 64
—, ill results from deprivation of in diet, 64
—, maize and rice, nutritive quality compared, 86
—, milling and polishing of, harm done by, 159
—, production in India, recent increase, 22
—, source of carbohydrate and Vitamin B, 68
—, yields in China and the United States compared with those in India, 194
— and-legume-eaters and rice-and legume-eaters, physique compared, 171
— and other grains, mixed diet of, 98
Widowed females, Hindu and Muslim (age-group 15–40), numbers compared, 225, 226
Widows, number per 1,000 females among Hindu castes and Mohammedans respectively, 236
—, remarriage of, effects on population, 225
Widows, remarriage of, legislation regarding, required, 228
—, — —, prohibition, 230
—, — —, restrictions on, 235
Wilson, Prof. H., defective diet of three children's institutions in Calcutta, 159
—, measurements of A. C. H. (arm-chest-hip) index of nutrition, 162
Wiser, Charlotte V., result of food-research by, 79
Women, addiction to drink, 185
—, diseases exercising specially lethal influence upon, 234
—, malnutrition in, effects of, 43
—, paucity of, regions and zones showing, 234
—, rendered incapable by midwife of bearing any more children, 218
Wong, investigations into protein ingestion and nitrogen excretion in China, 71
Work, moderate, and heavy, calories required for, respectively, 83
Workers, loss in numbers of, in industries, xii
Working-class families, housing utensils and furniture of, 181
— — —, of Cawnpore, monthly expenditure on miscellaneous items, 182
— — — — —, percentage of expenditure by, 181
— classes, expenditure on drink by, 184
Workmen, hook-worm infection in, how caused, 180
World economic depression, effects of on India, 205
Wright, commonest cause of blindness in Madras Presidency, 165
Wright, S., on vegetable proteins, 56

Xerophthalmia, 162
— in Southern India, 163

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